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AMERICAN

DYESTUFF REPORTER

Devoted to Textile Chemistry
BLEACHING • DYEING • PRINTING • FINISHING

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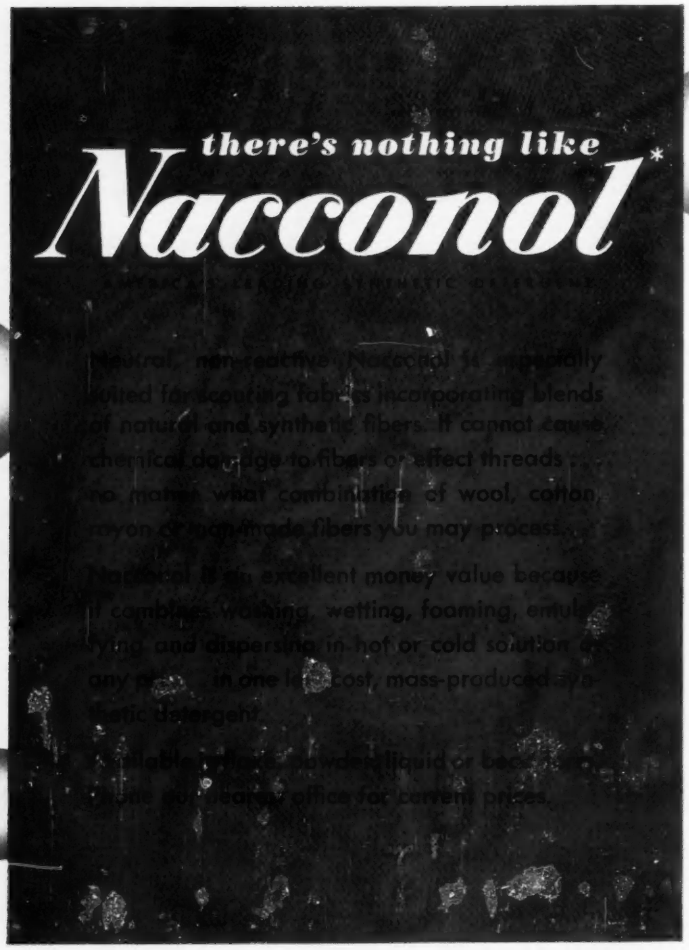
for safe, speedy scouring of new fiber blends



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December

Proceedings of the

American Association of Textile Chemists and Colorists

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Editor of Proceedings: Carl Z Draves, 30 Lahey St, New Hyde Park, N Y

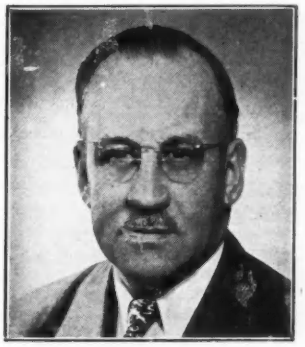
DECEMBER 20, 1954

JACOBY ELECTED 13th AATCC PRESIDENT

Baxter, Jones, Linberg and Scott to Serve as Vice Presidents

RAYMOND W JACOBY
President

GEORGE L BAXTER
Vice President
(Central Atlantic Region)



GEORGE O LINBERG
Vice President
(New England Region)

RAYMOND W JACOBY of Mountain Lakes, N J, will become the 13th president of AATCC next month as the result of the recent election of officers by the Association electorate. Mr Jacoby, technical consultant for Ciba, Co, Inc, was unopposed.

Vice presidents, representing the Association's four regions, were elected as follows:

Central Atlantic Region———George L Baxter, Bradford Dyeing Association

New England Region———George O Linberg, Synthron, Inc

Southern Region———Walter M Scott, U S Department of Agriculture

Western Region———Joseph H Jones, Phoenix Dye Works

Mr Jacoby succeeds J Robert Bonnar, General Dyestuff Co, to the presidency.

Dr Scott succeeds Samuel L Hayes, Ciba Co, Inc, vice president (Southern Region) for the past three years. Under Article V, Section 4 of the AATCC Constitution Mr Hayes was ineligible for re-election.

Messrs Baxter, Linberg and Jones are incumbents.

JOSEPH H JONES
Vice President
(Western Region)

WALTER M SCOTT
Vice President
(Southern Region)

AATCC CALENDAR

(A general calendar of events may be found on page 904)

COUNCIL
Jan 21 (Hotel Statler, New York), Apr 28, June 17.

NATIONAL CONVENTIONS
Sept 22-25, 1955 (Chalfonte-Haddon Hall, Atlantic City, N J; 1956 (Waldorf-Astoria, New York); 1957 (Boston).

HUDSON-MOHAWK SECTION
Jan 14, Feb 25, April 15 (Albany, N Y); May 20 (Ladies Night); June 24 (Annual Outing).

NIAGARA FRONTIER SECTION
Jan 14 (Buffalo); Mar 4 (Hamilton. Ont); April 22 (Buffalo); June 24 (Outing).

NEW YORK SECTION
January 28 (Georgian Room, Hotel Statler, New York); February 25 (Skytop, Hotel Statler, New York); March 18, April 22, May 20 (Kohler's Swiss Chalet, Rochelle Park, N J).

PIEDMONT SECTION
Jan 29 (Poinsett Hotel, Greenville, S C); Apr 30 (Robert E Lee Hotel, Winston-Salem, N C); June 10-11 (Mayview Manor, Blowing Rock, N C); Oct 29 (Hotel Wm R Barringer, Charlotte, N C).

WASHINGTON SECTION
Feb 11 (Washington); May 20.

WESTERN NEW ENGLAND SECTION
Jan 28, Mar 18 (Rapp's Restaurant, Shelton, Conn); May 13 (Ladies Night); June 17 (Annual Outing); Sept 16 (Rapp's); Nov 4 (Hartford, Conn); Dec 16 (Rapp's).

EMPLOYMENT REGISTER

This column is open for two insertions per year, per member, without charge. Blanks can be obtained from, and filed with, the Secretary of the Association, Lowell Technological Institute, Lowell, Mass. It is understood that these will be open to inspection by prospective employers who can obtain further information from the Secretary.

54-39

Education. B S, textile engineering and chemistry

Experience: Testing, quality control; supervision of bleaching, dyeing, printing & finishing.

Age: 31; married; references.

12-20, 1-3

Membership Cards

Membership cards have now been mailed to all members who have paid their dues. Any member not receiving his card within two weeks of payment should notify the Secretary:

Dr H C Chapin, Secretary
American Association of
Textile Chemists and Colorists
Box 28, Lowell, Massachusetts

ACTIVITIES OF THE LOCAL SECTIONS

MID-WEST———The Fall meeting of the Mid-West Section was held at the Bismarck Hotel, Chicago, Ill, on October 30, 1954. At the afternoon session, with vice chairman Hultberg presiding, Elliott Morrill, chairman of the new Scholarship Committee, explained the function of the committee and summarized its efforts to date. It was voted that the yearly scholarship award be continuing but not cumulative, and that the recipient for one year be thereafter in competition with all other applicants.

Presented by Mr Klein for the Nominating Committee, the following were elected officers for next year: *Chairman*———Arthur I Hultberg, Bear Brand Hosiery Co; *Vice-Chairman*———Samuel M Littlejohn, Munsingwear Inc; *Treasurer*———Jack G Kelley, Du Pont; *Secretary*———Harry W Ericson, American Aniline Products, Inc; *Councilors*———Eric W Camp, National Aniline Div, Samuel Klein, American Cyanamid Co, and L B MacFarland, American Aniline Products, Inc; *Sectional Committee*———John Nerl, American Aniline Products, Inc, Francis J Connolly, Morgan Dyeing & Bleaching Co, Otto R Grulke, Coopers, Inc, and Reinhold Kriewall, Evenknit Hosiery Co.

In the absence of Prof Burnham, chairman of the Stream Pollution Committee, Mr Brainerd presented the report of the committee.

Guest speaker of the afternoon session was Howard Leventhal, Visking Corp, on "Nonwoven Fabrics." In the evening, following dinner, Robert Ford, Dow-Corning Corp, spoke on "Silicones for Textile Finishes."

Approximately 80 members and guests attended the afternoon session, and 91, the evening session.

(See meeting photos on page P883)

* * * *

WESTERN NEW ENGLAND———Approximately 45 members and guests were present for the November 12th meeting of the Western New England Section at Rapp's Restaurant, Shelton, Conn, to hear Harry Creegan, James Hunter Machine Co, speak on "Mechanical Aspects of Dyeing and Finishing."

* * * *

NEW YORK———Francis S Richardson, Waldrich Co, spoke on "The Barotor in Practical Application" at the November 19th meeting of the New York Section, held at Kohler's Swiss Chalet, Rochelle Park, N J.

Henry L Young, chairman of the Nominating Committee, reported the following selections for councilors for a three-year period: John H Hennessey, Berkshire Color & Chem Co, and William F Brommelsiek, Forstmann Woolen Co. They were unanimously elected.

MEMBERSHIP APPLICATIONS

November 16, 1954

STUDENT

Stanley Cear—Philadelphia Textile Institute. Sponsor: W H Hughes.

Octavia A Martinez—Philadelphia Textile Institute. Sponsor: W H Hughes.

Ralph S Turry—Philadelphia Textile Institute. Sponsor: W H Hughes.

Howard Turchin — Fairleigh Dickinson College. Sponsor: H R Mauersberger.

Foline Velantzas — Lowell Tech Inst. Sponsor: G R Griffin.

Donald M Hankins — Georgia Inst of Technology. Sponsor: W Postman.

APPLICATION FOR TRANSFER TO SENIOR MEMBERSHIP

Lamar C Cloninger
Henry Pike
Harold R Ronson
Norman D Wonch

December 3, 1954

SENIOR

Southworth F Bryan — Treasurer, The Jefferson Mills, Inc, Jefferson, Ga. Sponsors: T Bohannon, Jr, C O Starnes.

William J Cunningham—Chemist, Rohm & Haas Co, Bristol, Pa. Sponsors: W G Fuhrman, P Theel.

Walter N Dow—Chemist-colorist, American Cyanamid Co, Dyestuff Dept, Boston, Mass. Sponsors: M P Graham, M E Johnson.

Harry W Embart — Lab tech, General Dyestuff Co, Philadelphia, Pa. Sponsors: W L Fickert, E G Haack.

John J Nihill—Colorist, National Aniline Div, Allied Chem & Dye Corp, Buffalo, N Y. Sponsors: S J Puliafico, N Battistelli.

(Concluded on Page P896)

FALL MEETING — MID-WEST SECTION — OCT 30, 1954 — BISMARCK HOTEL, CHICAGO, ILL

Standing: **J G Kelley, Du Pont, treasurer; Harry Ericson, American Aniline, secretary; J H Jones, Phoenix Dye Works, national vice president.** ***Seated:*** **Harold Leventhal, Visking Corp, afternoon speaker; Arthur Hultberg, Bear Brand Hosiery, vice chairman; Robert Ford, Dow Corning, evening speaker; J G Stott, Ciba, chairman.**

Standing: **Earl W Hazekamp, General Dyestuff; J L McGowan, Morgan Dye & Bleach; John L Eick, General Dyestuff.** ***Seated:*** **W D Paine, General Dyestuff; George Chabot, Jr, American Cyanamid; Carl Helm, American Cyanamid; James O'Malley, Jacques Wolf.**

Standing: **Earl Schroeder, Prospect Chem Co; Al Rathke, Contour Hosiery; Jake Lorcke, Kendall Corp (retired); Richard Waski, American Cyanamid.** ***Seated:*** **Clarence Willie, Kendall Corp; Vic Lawrence, Wm La Vey and Geo Fanby, Maher Color & Chem.**

(L to r): Al Kidder, Western Felt Works; Meta Metze, Stix-Baer & Fuller; Bernie Therrion, Western Felt Works.

Southeastern Section——

SUMMARY OF AN OPEN-FORUM DISCUSSION ON

"THE APPLICATION OF VAT AND DIRECT DYES"*

Question: What is the best method for covering dead (immature) cotton in fabrics that are to be dyed with vat dyes or naphthols?

Answer: Full mercerization of a fabric is the only feasible method that has been suggested to increase the affinity of dead cotton sufficiently to get reasonably solid coverage.

The discussion was concerned mostly with keeping out dead cotton and with the use of Micronaire readings to recognize the presence of immature cotton.

Q: What aftertreatments are available for increasing the light and wash fastness of direct dyestuffs?

A: Only selected direct dyes can be effectively improved in light and wash fastness by aftertreatment. Such selections have been made by different dye manufacturers, the most suitable dyes often being offered under special names. Each firm offers at the same time a special, cation-active, sometimes resinous, aftertreating agent, which either already contains a copper salt or is to be used with a copper salt. Both light and wet fastness can be considerably improved by such aftertreatment in the case of the selected direct dyes. Such dyes are applicable on cotton in any form, including yarn and stock in circulating machines as well as on piece goods on a padder.

Q: What is a good wetting agent to wet out loop and cut-pile cotton rugs prior to dyeing?

A: Many effective wetting agents on the market are suitable, but they must be suf-

PANEL

R B Hallowell, *chairman*
Clark Thread Co
Frank H Cooper, Jr
A & M Karagheusian, Inc
James H Stradley
E I du Pont de Nemours & Co, Inc
Robert H Harris
Spalding Knitting Mills
Howard T McCamy
Pepperell Mfg Co
Robert H Nuttall
American Aniline Products, Inc
Boyce C Bond
Pittsburgh Coke & Chemical Co

A summary of the discussion following each question put to the Panel is offered by John C Cook, Secretary of the Southeastern Section.

* Conducted at the Spring Meeting on March 27, 1954, at the Ralston Hotel in Columbus, Ga.

ficiently mild not to affect the jute backing; they must also not cause the oil in the jute to stain the pile.

However, since jute yarn can be spun just as well with an oil content of less than 1% as with 6, 7, or 8%, there is no reason why an oil loading of more than 1% on the jute yarn or hessians should be tolerated by manufacturers of rugs that are to be dyed in the piece.

Q: How does salt affect dyeing mechanisms?

A: Salt often causes pitting in metal. The degree of pitting is dependent upon the quality of metal that comes in contact with the salt. For example, different qualities of stainless steel differ widely in resistance to various corrosive conditions.

Q: How does salt quality affect the dyeing of vat and direct dyes?

A: The calcium and magnesium content of the cheaper qualities of common salt quite adversely affects the dyeing of direct and vat dyestuffs and makes necessary the use of a sequestering agent.

Purified salt containing less than a total of 0.03% of calcium and magnesium salts is offered by all the large salt companies. A dissolving mechanism can be installed for preparing solutions of purified salt that are not only free of calcium and magnesium salts but also of solid impurities. Suitable mechanisms are also available for dissolving the cheaper grades of salt to deliver solutions that are free of solid impurities. The cheapest grade, rock salt, is used in some mills for other purposes and can also be prepared free from solid impurities but should not be used for any dyeing because it contains such a relatively high proportion of calcium and magnesium. The latest development in salt technology is the use of ion-exchange equipment for removing soluble calcium and magnesium salts from solutions of the cheaper grades of common salt.

Q: Does the dyeing of vat colors at high temperatures reduce light fastness?

A: Some vat dyes are slowly decomposed by reduction and dyeing in the presence of caustic soda and hydrosulfite at high temperatures, some being affected even in five minutes at temperatures of 180°F or so, whereas others are quite stable. Such decomposition is usually evidenced by changes in shade and strength as well as in light and chlorine fastness.

Newer application methods and equipment permit the use of many vat dyes at high temperatures that were formerly considered unsuitable for high-temperature dyeing. By the use of sodium formaldehydesulfoxylate and caustic soda for reduction and dyeing it also seems to be possible to dye even the most sensitive vat dyes at elevated temperatures.

Q: What advantages are gained from the use of retarding agents in vat dyeing?

A: The answer depends very much upon the particular vat dye and the method of dyeing. A long paper would be required for a full and satisfactory discussion of the use of retarders in vat dyeing. Such common things as glue, soap, and lignocellulose sulfite are used by some dyers. The absence of calcium salts in such assistants is always most important. Others prefer synthetic products, such as polyethanoxy and other newer types; still others, especially Europeans as explained by M R Fox, depend considerably upon temperature control. Those vat dyes that exhaust best at 140°F dye quite slowly at 80°F.

Retarding agents are not important for the attainment of the best penetration and levelness by padding methods with dispersed pigments, acid leucos, or leuco esters.

Q: What methods should be used to correct the bleeding of naphthol-dyed yarn into adjacent white yarn when fabrics containing naphthol stripes go through a water mangle after bleaching?

A: After coupling, rinse the colored yarn at once in a 2 to 2½% solution by weight of conc muriatic acid (32°TW). After bleaching, wash the fabric with a little alkali to minimize crocking.

Naphthol dyeings after coupling should always be thoroughly soaped with a nonionic detergent and a lime-sequestering agent at as high a temperature (160°F or near the boil) as the particular combination will withstand to remove loose color and thus to obviate subsequent bleeding and crocking.

Q: What affect do the pH and the hardness of water have on the dyeing of vat and fast-to-light direct dyes?

A: The pH of the water for dyeing vat dyes (within reason) has no effect on the final results because the pH of a vat dyebath is overwhelmingly determined by the alkali used in the dyebath.

Most direct dyes are very little affected in dyeing by traces of soda-ash alkalinity, but traces of acid are likely to cause precipitation.

Hardness in water has a distinct detrimental effect on most direct and vat dyes, the vat blues, for example, being especially sensitive to precipitation with lime salts. Water for dyeing both of these classes of colors should therefore either be soft or be treated with softening or sequestering agents.

Q: What are the comparative advantages and disadvantages of paste and powder brands of vat dyestuffs?

A: Those who use vat dyes in small quantities or infrequently prefer to store powders rather than pastes because pastes dry out on occasional exposure. Some paste brands, especially those used in printing, contain hygroscopic organic substances like glycerine, which tend to prevent drying out. Powders are also preferred by some because they find there is more wastage in weighing out pastes.

As for working properties, most dye manufacturers have found it easier to prepare pastes in excellent dispersed form than powders that disperse equally well when simply stirred into water. It is for this reason that most efforts to prepare vat powders for printing have not been too successful. Most dyers have thus had more confidence in pastes than powders for pigment padding and for circulation of pigment in circulating machines before reduction.

By improved techniques, however, more and more powder brands are being manufactured that compare very favorably with pastes for quality of dispersion for pigment padding and pigment circulation. These powders are made to be equal in strength to corresponding single or double pastes, that is, they must contain approximately 80 to 90% of dry standardizing and other agents, that must not interfere seriously with dispersion.

Recently progress has been made in preparing powders of better dispersibility by making them several times stronger than single-paste brands and thus eliminating much of the dry standardizing agent, which may interfere somewhat with the dispersive properties of vat pigments. These concentrated powders are of course high in price because they are so strong, but they are really somewhat more economical in total color cost. They are said to form excellent dispersions for padding and pigment circulation and are being used in foreign countries for printing.

Q: Are vat dyes being applied currently on acetate?

A: Vat dyes are claimed advantageous for better chlorine fastness on acetate. They have been applied in a small way on acetate hosiery yarn in hank form from a cold solution containing a high concentration of alcohol. The method is still experimental.

Very good (4) fastness to washing (no loss or stain in Cotton Wash Test #3) can be obtained with naphthols and diazotizable organic bases on acetate by a special method, the fastness to washing being much better than that of disperse (acetate) dyes. Naphthols, like vat dyes, have the further advantage on acetate of not being subject to gas fading.

1954 Intersectional Contest——

STUDIES ON THE ACCEPTABILITY AND PERCEPTIBILITY OF FADING*

NORTHERN NEW ENGLAND SECTION

COMMITTEE

Charles A Lermond,
Chairman and Speaker
Fabric Research Laboratories, Inc
Roland E Derby, Jr
The Derby Co, Inc
Kenneth L Dorman
Goodall Sanford, Inc
Walter E Flister
Barre Wool Combing Co, Ltd
Ernest R Kaswell
Fabric Research Laboratories, Inc
Robert D Robinson
Bachman Uxbridge Worsted Co, Inc

Frequently, thousands of yards of fabric may be passed or rejected based on the results of a single light-test evaluation by a single observer. Since considerable economic significance is attached to these results, the importance of studying the variables of exposure-techniques and evaluation methods would seem clear.

In this paper an introductory study is instigated for the purpose of determining the magnitude of the variations involved in evaluation by visual and instrumental means and crystallizing the path which future work should follow.

The experiments were carried out by eighteen observers on eighteen shades strategically scattered throughout textile color space. Three degrees of fading were exhibited by each shade. The results are equivalent to nearly 1,000 matchings. The average equivalence of fade from one region of color space to another, in terms of the Adams-Nickerson Color Difference formula is determined. The problem of metamerism is investigated in a second experiment involving fourteen samples and sight observers, each observer repeating at least once. In all cases the basic colorimetric data are provided in order to make the data useful for trials of newly developed color-difference formulas. The well-known difficulties with the Adams-Nickerson formula are shown to be demonstratable with this set of data.

INTRODUCTION

THE importance of testing the light fastness of dyestuffs was recognized at least as early as 1733. At that time extensive experiments were carried out by M Dufay of The Royal Academy of Sciences in order to determine the characteristics of all dyes available at that time. The goal was to classify them either as "greater" (fast to light) or "lesser" (fugitive) in order that specifications might be issued for dyeing (*1*).

Today, light fastness is one of the most important characteristics of dyes, fibers and their various combinations. It is of considerable concern in meeting certain contractural agreements and in avoiding rejections by the customer. The net result of these requirements are extensive laboratory testing programs carried on throughout the world, wherein representative samples are exposed to the appropriate radiation and the resulting degradation determined as a function of time.

As might be realized, where such economic consequence is attached to the result of a test, a great deal of effort has been expended in studying the variables associated with the procedure. Work along these lines up to 1949 has been thoroughly summarized (*2*).

One phase of any testing program is concerned with evaluation. In the case of light tests, this involves some sort of judgment as to equality of resulting color differences. This is true whether the comparison is being made to a standard swatch acceptable to the customer, or to standards specified by national and international organizations.

Under any circumstances the situation resolves itself into one of deciding when one three-dimensional color change is "equal" to another, equality in this case being represented by subjective judgment.

In order to illustrate the nature of the problem, let us consider several formulations all of which match the standard for shade. It is desirable to determine which of the lot offers the best light fastness, and further, which, if any, is better than the standard (which is acceptable).

One technique of handling this involves exposing all samples for the desired time and then comparing the resultant color changes. In most cases a multitude of different alterations would occur and the examiner is faced with the problem of deciding whether the "green" fade is equal to, or better than, the "red" fade, etc. Since, at the same time, certain personal bias may enter into the evaluation, the result is subject to argument; particularly if one happens to be a proponent of the alternate formulation, or if it happens to be one's pieces that are being rejected.

The desirability of evaluating fading-test results instrumentally is clear cut, at least in reference cases, provided one can be sure that the instrumental results correlate with the average of visual judgments.

The principle behind physical evaluation is relatively simple. Each color change is broken down into three components, i e, a lightness factor, a hue factor, and a saturation or chrome factor. This is completely analogous to the usual vector representation of forces. In fact it is desirable to consider the unfaded portion as the origin and to imagine all fades resulting in a vector in the three-dimensional space specified. All so-called "color-difference formulas" attempt to destroy this special relation insofar as angular dependence is concerned. This is accomplished by means of scale changes along the co-ordinate axes involved. If this is correctly performed, equal length vectors will represent equal color differences regardless of direction. It is also desirable that, once the magnitude of a certain fade for one shade has been determined, the relation of this to another completely different shade be determinable

Over the years a great deal of effort has been expended in developing formulas which would enable the proper evaluation to be made of the measured reflectance difference between the unexposed and exposed part. Today it is possible with certain limitations to utilize these results. At present, however, no existing formula can be called completely satisfactory and the search for improved formulations goes on.

It is emphasized that the problems of comparing one fading to a standard fade of a different shade is always metameric in nature; therefore the well-known problem of metameric matches and observers who "see toward artificial light" enters each case. In other words, we must be certain that the instrument "sees" the unexposed and exposed portions to be the same shade as the average observer does. About all that can be said here is that

* Presented by Charles A Lermond at Atlanta, Ga, on Sept 19, 1954.

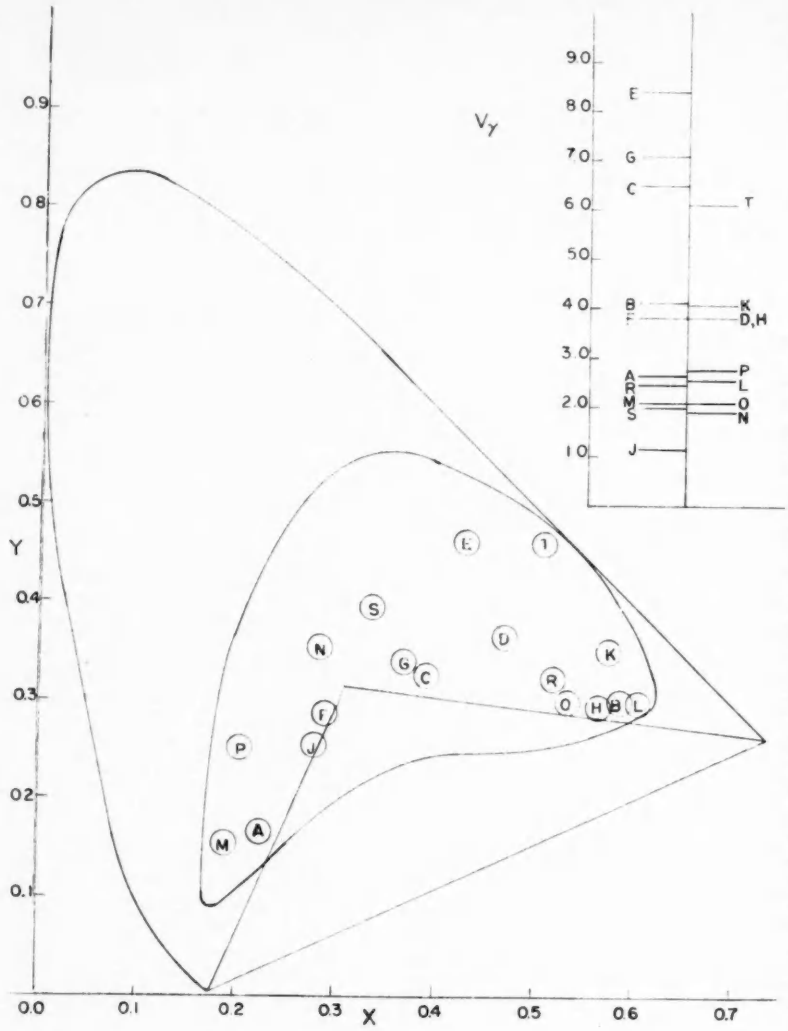


Figure 1

A chromaticity plot of the various samples used in the investigation together with a scale showing the corresponding Munsell value levels.

statistically this condition is met. It should also be noted that the widely used grey-scale techniques of evaluation are subject to the limitations mentioned above.

One purpose of this paper is to instigate certain lines of research into the variables with both instrumental and visual evaluations. In particular, it would seem desirable to make available, by means of colorimetry, fundamental data on the ability of observers to rate fade tests. In addition, the equality of fades carried out on different shades would be most useful. Lastly, the magnitude of an acceptable fade in terms of basic color data would be important.

Although we have made use of one widely utilized color-differenee formula in this paper (*3*), it is intended mainly to be illustrative; its limitations are well known. An additional aim of this paper is to provide a set of basic data which can be employed to test any new formula which may seem worth considering. When one considers the nature of proximity factors, contrasts, sharpness-of-separating-line and others, it seems almost too much to expect that color-difference formulas devised for ordinary color comparison (swatch to swatch) could be used without modification.

It is evident that the meager sampling of color space and the small number of observers employed hardly seem adequate for the problem at hand. However, it is a beginning which should at least demonstrate the nature of further data desired. It is regrettable that the thousands of evaluations performed by various comittees and task groups could not have been recorded in terms of fundamental data so that progress towards the "best" answer could have been made more rapidly. This is no criticism of those concerned, but a matter of temporal and territorial difficulties.

PREPARATION OF SAMPLES

The number of shades which could be used in this type of investigation is necessarily large both from the standpoint of classes of dyestuffs and also from the number of potential fabrics on which the dyeings could be made. The first condition imposed was that all dyeings be made on a standard wool laboratory cloth. The portion of color space which is actually occupied by textile dyeings is rather limited, and in this experiment, the goal was a fair representation of this space with as few samples as possible. The actual samples used are shown in Figure 1 as plots on a standard chromaticity diagram together with their respective Munsell Values. Figure 1 also shows the approximate boundary for textile color space (*4*). It should also be mentioned that all dyes used are among the commonly available wool dyes and, in most cases are "combination" dyeings, such as would be encountered in the trade.

Each sample was of sufficient size so that three separate portions (2½" x 4") could be cut from it for exposure in the Fade-Ometer. The cards on which the samples were mounted had apertures 1½" x 2" to allow exposure of only half of the sample. Prior to our fading the entire lot, one from each series was faded to the point of just perceptible fade as judged by the technician preparing the samples. Based on the time necessary to reach perceptibility of fade for any sample, the other two were faded 5-10 hours either side. This procedure was repeated until a satisfactory group was prepared. Since the Fade-Ometer is not sufficiently large to accommodate all of the samples at any one time, the greatest number of hours does not necessarily correspond with the worst fade. It proved difficult to reproduce fadings to within 5 hours on the basis of 20-30 in the Fade-Ometer.

After the samples had all been faded, sheets of white cardboard were placed between the samples and their mounts to assure that both the exposed and unexposed areas had the same backing. In order to avoid giving the observer any indication as to how many hours a given sample had been faded, code letters were used on the back. No two sets had the same series of letters. The mounted and coded samples were then placed individually in envelopes so as to minimize soiling, and observers were instructed to handle

samples by the edges in order to further minimize damage.

RANKING OF SAMPLES

Although the form for reporting the data had explicit instructions for evaluating the samples, a coach was always present to answer any questions and record the observations. The actual observers were people experienced in the field of color matching and fade-test evaluation.

Since there is always a possibility that difference in illumination will cause differences in the way a given observer ranks a set of samples, it was specified that all comparisons should be made under a Macbeth "daylight" color-matching lamp. This obviously limited the number of locations from which observers could be obtained.

The observers were first asked to rank the samples in the order of increasing fade. If they could not distinguish between any two samples they were to so state by marking "ND" in the spaces provided instead of the proper code letter. In cases where there appeared to be no difference between the three samples the figure 1 was used for all samples. Where there was no difference between two samples the lower value was used for both samples.

At an intermediary point in the evaluation all the samples were recalled for instrument evaluation. It was considered better to measure the samples at this point than at the start or end of the testing since any mishandling of the samples would be more nearly averaged out. Spectrophotometric curves were run in duplicate on both the exposed and unexposed areas of each sample using a G E recording spectrophotometer equipped with an automatic integrating attachment for obtaining the tristimulus values. From these values it was possible to calculate the color differences between the two areas of each sample using the Adams Color Difference formula:

TABLE I

SUMMARY OF OBSERVER AND INSTRUMENTAL RANKING

Shade	Instrument Ranking	Observer Ranking 1	2	3		Color Difference
A	1	13	5	—		1.16
	2	5	13	—		2.04
	3	—	—	18		2.20
B	1	17	2	—		1.16
	2	2	16	—		1.80
	3	18	—	—		2.84
C	1	17	2	1		1.28
	2	1	15	3		1.52
	3	1	2	15		1.72
D	1	18	—	—		1.08
	2	—	18	—		1.12
	3	—	—	18		1.20
E	1	17	4	3		0.88
	2	5	9	10	ND	1.64
	3	2	11	9	ND	1.68
F	1	16	—	3		1.00
	2	3	2	14		1.12
	3	—	17	2		1.32
G	1	17	3	—		1.60
	2	2	14	5		1.72
	3	2	5	13		1.80
H	1	13	5	—		1.12
	2	5	11	2		1.40
	3	—	2	16		2.16
J	1	10	6	8	ND	0.40
	2	10	6	9	ND	0.56
	3	4	12	6		0.92
K	1	3	8	1		0.52
	2	7	11	4		1.28
	3	2	2	15		1.68
L	1	5	6	12		0.40
	2	10	9	5		0.68
	3	8	7	6		0.80
M	1	15	3	—		1.00
	2	4	13	1		2.52
	3	—	1	17		3.24
N	1	8	9	5		0.44
	2	7	8	7		0.92
	3	7	5	9		1.24
O	1	1	18	—		0.08
	2	17	1	2		0.64
	3	2	—	18		1.04
P	1	8	12	—		0.84
	2	12	8	—		0.88
	3	—	—	19		1.08
R	1	8	7	8		1.20
	2	6	6	9		1.20
	2	9	10	4		2.84
S	1	—	9	10		0.56
	2	1	10	8		0.84
	3	18	—	1		1.04
T	1	18	2	1		0.40
	2	2	18	1		1.04
	3	1	1	19		1.48

$$CD = 40\left\{(0.23\triangle V_Y)^2 + [\triangle(V_X - V_Y)]^2 + [0.4\triangle(V_Z - V_Y)]^2\right\}^{1/2}$$

Based on the differences shown by these calculations, the sample codes were changed to 1,2,3 instead of the original letter codes. The ranking is summarized in Table I together with the corresponding color differences. In cases where an observer called two or more samples equal it was necessary to consider all the possibilities at each ranking level. Thus the number reported in any one row does not necessarily correspond with the number of observers involved.

The observers were asked to circle the sample in each group which they thought was the limit of acceptability as far as fading was concerned. In many cases some observers felt that all samples in a group were acceptable. There was only one case where the observer felt that no sample in the group was acceptable. The data are shown in Table II. It is perhaps more informative to look at the data in a form which shows how many were willing to accept any one fading within the group. In many cases the boundary of acceptability is clearcut but in others there is confusion. The general agreement is much better in the order ranking of the samples than it is for the limit of acceptability of fading. This is probably to be expected since the latter classification involves introspection on the part of the observer.

An earlier experiment was carried out by observers who were asked to rate the fading in a series of matches of olive green. Each match comprised a different dye formulation. All samples were faded an equivalent number of standard Fade-Ometer hours. The observers were asked simply to rate the samples in order of increasing fade. In each case the observer was asked to make several trials. The results are shown in Table III. It is interesting to note that there is considerable disagreement both between observers and also within the rankings of any one observer.

As a final part of each judgment the observers were asked to rate the levels of fading in terms of what they felt was equivalence. In doing this they were asked to find in each set a sample which they felt matched the amount of fade found in the sample of Group A (Tables IV and V). It was hoped many of the discrepancies shown here could be attributed to the different spectral regions in which the samples were located since the color difference formula in its current form is known to suffer from this defect.

DISCUSSION

As mentioned in the introduction, the purpose of this paper is to reveal certain difficulties associated with both visual and instrumental evaluation of light fastness tests. Further, it is intended to provide instrumental evaluation of these problems in as general terms as possible.

In examining these tables, one must bear in mind the statistical nature of the problem, i e, what percentage of the observers rank each sample in its "appropriate" position (Table I). It can easily be seen that in certain cases the consistency is very good, in others poor. It would seem that when the correlation is poor the amount of difference between fades within that sample is not "appreciable."

In some instances, for example samples O and S, serious discrepancies between the visual and color difference ranking occur, practically a negative correlation existing in these samples. Their difficulty may be due to one or a combination of factors. First, the instrument (General Electric spectrophotometer and integrator) may not be "seeing" the exposed and unexposed portions to be the same color as it appears to the observers. Although thousands of measurements indicate this to be a fairly rare phenomena (perhaps 1-2% for textiles) it is known that the illuminant used in the CIE calculation differs from the Macbeth light both in spectral distribution and color temperature, the latter being slightly towards tungsten light. In addition, the CIE standard observer is known to "see" slightly towards artificial light. The second factor is the color-difference formula employed. If it is a matter of the spectrophotometer-observer not seeing the difference, then we are in serious difficulty. However if it is merely that the color-difference formula does not weight the components (hue, value, chroma) properly, correction could be expected from a better formula.

It has been noted that in certain other cases the Adams formula did not seem to weight "on" and "off" tone fading properly. In other words, the chroma vector was weighted too heavily relative to the hue vector. Of course, the chrome vector is merely a special case of the hue vector; however, it has the characteristic that it is the hue vector which can suffer the greatest change (in length) before becoming observable. It would seem that the data of MacAdams (5) would do a better job in this respect. However, his data have not been refined to the extent that the proper weighting factors for fading tests have been determined. Extensive work toward this end is in progress, and it is hoped to apply the results to the data of this paper in the near future.

The chromaticities and lightness values of each sample are shown in Figure 1. The sampling is fairly good for the limited samples employed, more samples in the yellow-green and violet being desirable. It is probably reasonable to assume that it is safe to employ the Adams formula in regions where good correlation with visual results is shown for samples which are not badly metameric.

The *average* equality of Adams color difference is shown in Table V. The range is also shown in order to indicate the magnitude of variation. Its size indicates more testing is needed in order that the average may be specified more precisely. The large values for the range may indeed be a function of the particular color-difference formula employed. By use of the data provided here statistical calculations as to the "equality" of color differences from one hue region to another can be made for any given case. It is apparent, however, that much more work is needed to define these values more rigorously, even for the small number of color space points involved in this experiment.

TABLE II
ACCEPTABILITY OF FADE

Number of Observers Accepting Any Given Fading

Shade	N	Fading Number 1	2	3	4
A		16	11	9	
B		15	15	8	2
C		16	5	3	
D		15	13	7	1
E		16	16	14	8
F		16	11	8	3
G	1	15	2	1	
H		16	15	10	3
J		16	13	7	6
K		16	12	11	3
L		16	12	12	11
M		16	11	8	
N		16	13	10	6
O		16	11	9	1
P		16	15	14	4
R		16	9	7	6
S		16	9	8	2
T		16	15	10	6

N = Non Acceptable
A = All Acceptable

TABLE III
RANKING OF FADING TESTS BY DIFFERENT OBSERVERS

On Fadings of a Metameric Match
80-Hour Fade-Ometer Exposure

Instrumental Ranking	Observer A-1	A-2	A-3	A-4	B-1	B-2	B-3	C-1	C-2	D-1	D-2	E-1	E-2	F-1	F-2	G-1	G-2	H-1	Color Difference	Direction of Fade
2	1	4	4	4	1	4	4	4	4	8	1	9	1	9	1	1	1	4	0.696	Orange-Red
5	2	2	5	1	4	1	5	1	5	4	2	8	5	5	5	5	5	10	1.150	Violet
6	3	9	10	5	8	5	1	5	9	1	4	4	8	4	4	4	10	8	1.160	Orange
10	4	8	1	8	5	9	6	8	10	5	5	5	4	1	2	9	4	6	1.410	Red
1	5	1	6	10	9	10	2	9	8	2	6	1	6	8	9	10	8	1	1.490	Blue-Violet
8	6	12	9	9	10	3	9	2	6	6	9	10	2	10	6	2	6	2	1.510	Violet
4	7	5	3	5	2	2	10	10	2	9	8	2	10	2	8	6	2	6	1.570	Blue-Violet
7	8	6	10	2	3	6	8	3	1	10	11	6	9	6	12	8	9	9	1.620	Red
9	9	10	2	11	6	8	3	6	3	3	3	12	12	12	11	3	11	11	1.680	Violet-Red
3	10	11	11	3	12	12	12	12	12	11	10	11	11	11	10	11	12	3	1.790	Blue
12	11	3	12	12	11	11	11	11	11	12	12	3	3	3	3	12	3	12	1.800	Red
13	12	7	7	7	7	7	7	7	7	7	7	7	7	7	7	13	7	13	1.900	Red
11	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	7	13	7	1.930	Violet
14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	2.620	Orange-Red

In this table, the ranking of Observer "A" 1st Trial is taken as standard. All numbers appearing in other columns refer to this except that the order is made to correspond to the ranking of the particular observer.

TABLE IV

EQUIVALENCE OF FADE USING A SAMPLE FROM SHADE "A" AS A POINT OF REFERENCE*

Shade	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A	3	3	3	3	3	3	1	2	3	1	1	1	3	3	1	2
B	2	2	3	3	—	3	2	3	3	2	2	2/3	—	—	2	2
C	½	1	½	1	3	3	3	1	1	1	—	0.5x1	1.5x1	1.3x1	—	1
D	3	2	2	3	—	3	2	2/3	3	—	1	0.7x1	3	3	—	2
E	—	3	—	—	—	—	2x3	3	2x2	—	2x2	3	—	—	2	—
F	—	2	3	2	—	2	1	1	2	—	3	1	2	3	1	3
G	—	1	1	1	1	1	1	1	1	—	0.5x1	1.1x1	1.5x1	2	—	1
H	3	2	—	2	—	3	2	3	3	3	2	2	—	1.3x3	2	3
J	—	3	2	—	—	—	3	2	—	2	2	1	—	—	1	2
K	3	3	3	3	—	—	3	3	2x1	3	3	1	1.3x3	2x3	1	2x2
L	—	3	—	—	—	—	—	—	2x2	1	1	1	—	—	2x2	—
M	3	2	1	3	3	3	1	3	3	.67x1	1	1	3	.75x3	2	2
N	—	3	—	—	—	—	1	2	2x1	1	3	2	—	—	3	1
O	3	1	3	3	—	3	1	—	3	3	1	2	3	3	1.3x1	3
P	—	3	3	3	—	—	3	3	1.3x3	2	2	2	—	3	1	3
R	—	—	—	—	—	—	2	2	1	1	1	3	1	—	1	1
S	—	1	3	1	—	1	3	1	1	3	3	3	1	1	3	3
T	—	2	—	3	—	—	2	—	3	3	2	—	—	1.3x3	3	2

* In some cases the observers felt there was no exact equivalent but tried to estimate.

The problem of metameric matches and their resultant effect on rankings is illustrated in Table III. This problem has been discussed briefly in the introduction. Examination of the table shows a rather poor correlation "between" and even "within" observers. However, the color-difference formula exhibits certain serious discrepancies, as for example one sample which no observer ranked worse than 4th, but which the color-difference calculation ranked 7th. The associated colorimetric data is shown in Table VII. The direction of fade is shown in Table III and indicates the variation involved.

In other words, as one might well expect disagreement on the "best" match by different observers examining swatches dyed with markedly different combinations of dyestuffs, so we should expect variations in fading-test evaluation on such metameric fadings. However, it is desirable that a color-difference evaluation at least correlate statistically with the visual data. That the Adams formula does not do this in a completely satisfactory manner is well known. This difficulty cannot be attributed to any great extent to the basic measurements of tristimulus values. It would seem that the data in Tables VI and VII should provide an excellent "first" test for the validity of any proposed color-difference formula.

Along these lines it would seem advisable to investigate the ranking of the same samples employed in this study under tungsten light. This would be interesting from the viewpoint of discrimination, since it is well known that color differences readily apparent in one source of illumination may become smaller in another. Further, it would be desirable to prepare a series of samples, not self shades, which, due to their "mixiness", would present a broken line at the junction between the faded and unfaded portion. Although such a series was prepared, difficulties attendant with measurement and evaluation precluded including the results in this particular study. However, samples were chosen whose average chromatic coefficient and lightness corresponded as closely as possible with certain samples employed in this study.

Other factors, such as type of surround, size of faded area, material used, etc, have not been studied. The results obtained when one sampled other areas of the textile trade would also be of interest.

TABLE V

EQUIVALENCE OF FADE

In Terms of Color Difference Units

Shade	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Ave	Range
A	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	0
B	1.80	1.80	2.84	2.84	—	2.84	3.41	2.84	2.84	3.41	3.41	—	—	—	3.41	2.12	2.79	1.61
C	1.35	1.28	1.62	1.28	1.72	1.72	3.26	1.28	1.28	3.42	2.43	1.21	1.92	1.92	—	1.51	1.51	2.05
D	1.20	1.12	1.12	1.20	—	1.20	2.12	1.16	1.20	2.12	2.05	1.44	1.20	1.20	—	1.32	1.42	1.00
E	—	1.68	—	—	—	—	1.59	1.68	3.28	—	6.22	2.19	—	—	3.11	1.98	2.76	4.63
																	*2.26	1.69
F	—	1.12	1.32	1.12	—	1.12	1.90	1.00	1.12	1.90	2.50	1.90	1.12	1.32	1.90	1.55	1.49	1.38
G	—	1.60	1.60	1.60	1.60	1.60	3.03	1.60	1.66	—	1.52	2.12	2.40	1.72	—	1.88	1.84	1.43
H	2.16	—	—	2.16	—	2.16	2.65	2.16	2.16	4.10	2.65	2.65	—	2.88	2.65	2.54	2.57	1.94
																	*2.43	0.72
J	—	1.36	0.56	—	—	—	0.76	1.36	—	1.06	1.06	0.76	—	—	0.76	0.66	0.87	0.80
K	1.68	1.68	1.68	1.68	—	—	3.19	1.68	3.36	3.19	3.19	0.99	2.26	3.36	0.99	1.23	2.15	2.37
L	—	0.80	—	—	—	—	—	—	1.36	0.76	0.76	0.76	—	—	2.50	1.55	1.22	1.74
M	3.24	2.52	1.00	3.24	3.24	3.24	1.90	3.24	3.24	1.27	1.90	1.90	2.52	2.43	4.78	2.97	2.66	3.78
N	—	1.24	—	—	—	—	0.83	0.92	0.88	0.83	2.35	1.74	—	—	2.35	0.52	1.29	1.83
O	0.52	0.32	1.04	1.04	—	1.04	0.15	0.56	1.04	1.97	1.97	1.21	1.04	1.04	0.19	1.27	0.96	1.82
P	—	1.08	1.08	1.08	—	—	2.05	1.08	1.44	2.73	1.67	1.67	—	1.08	1.59	3.35	1.65	2.17
R	—	—	—	—	—	—	2.28	1.20	1.20	2.28	2.28	5.38	1.20	—	2.28	1.41	2.16	4.18
																	*1.79	1.08
S	—	0.56	1.04	0.56	—	0.56	1.97	0.56	0.56	1.06	1.59	1.59	0.56	0.56	1.97	1.23	1.08	1.41
T	—	1.04	—	1.48	—	—	1.97	—	1.48	2.81	1.97	—	—	2.97	2.81	1.23	1.97	1.93

* Average and Range omitting value underlined.

TABLE VI

TRICHROMATIC COEFFICIENTS OF SAMPLES USED FOR THE EXPERIMENT

Shade	Instrument Ranking	Unexposed			Exposed		
		x	y	Y	x	y	Y
A	1	0.2190	0.1683	5.11	0.2203	0.1718	5.40
	2	0.2182	0.1663	5.18	0.2205	0.1725	5.40
	3	0.2185	0.1668	5.01	0.2208	0.1742	5.41
B	1	0.5866	0.3043	12.98	0.5818	0.3031	12.98
	2	0.5864	0.3046	12.82	0.5791	0.3032	12.87
	3	0.5855	0.3038	13.02	0.5757	0.3050	13.13
C	1	0.3911	0.3302	36.30	0.3866	0.3276	37.36
	2	0.3906	0.3297	36.34	0.3853	0.3265	37.33
	3	0.3882	0.3297	36.82	0.3831	0.3260	37.76
D	1	0.4681	0.3647	10.95	0.4643	0.3651	11.40
	2	0.4687	0.3649	11.00	0.4623	0.3642	11.32
	3	0.4677	0.3646	11.06	0.4605	0.3638	11.36
E	1	0.4279	0.4648	66.46	0.4256	0.4641	66.75
	2	0.4278	0.4662	67.54	0.4250	0.4638	67.54
	3	0.4284	0.4659	65.92	0.4253	0.4633	66.45
F	1	0.2889	0.2912	11.04	0.2902	0.2917	11.69
	2	0.2899	0.2921	10.92	0.2890	0.2897	11.25
	3	0.2891	0.2915	11.02	0.2893	0.2898	11.85
G	1	0.3683	0.3421	43.54	0.3653	0.3394	45.14
	2	0.3685	0.3421	44.59	0.3639	0.3385	45.64
	3	0.3677	0.3419	44.60	0.3638	0.3377	45.09
H	1	0.5645	0.2947	11.14	0.5590	0.2930	11.14
	2	0.5657	0.2953	11.10	0.5589	0.2947	11.15
	3	0.5681	0.2951	11.04	0.5585	0.2938	11.06
J	1	0.2789	0.2572	1.48	0.2778	0.2559	1.52
	2	0.2744	0.2538	1.36	0.2756	0.2536	1.44
	3	0.2762	0.2521	1.36	0.2738	0.2543	1.43
K	1	0.5760	0.3440	12.42	0.5743	0.3439	12.55
	2	0.5761	0.3440	12.41	0.5712	0.3435	12.60
	3	0.5795	0.3439	12.20	0.5732	0.3428	12.42
L	1	0.5981	0.3053	5.00	0.5958	0.3035	4.99
	2	0.5920	0.2993	4.72	0.5901	0.3006	4.91
	3	0.5935	0.2983	4.68	0.5895	0.2991	4.87
M	1	0.1901	0.1575	3.33	0.1936	0.1646	3.38
	2	0.1901	0.1577	3.20	0.1934	0.1644	3.25
	3	0.1907	0.1565	3.26	0.1957	0.1681	3.32
N	1	0.2850	0.3581	2.89	0.2865	0.3574	2.94
	2	0.2838	0.3562	2.90	0.2866	0.3523	2.98
	3	0.2830	0.3616	2.73	0.2884	0.3581	2.80
O	1	0.5338	0.2976	3.54	0.5336	0.2979	3.56
	2	0.5351	0.2981	3.42	0.5338	0.2963	3.44
	3	0.5389	0.2982	3.47	0.5317	0.2969	3.51
P	1	0.2062	0.2541	5.54	0.2077	0.2542	5.60
	2	0.2070	0.2567	5.56	0.2084	0.2569	5.62
	3	0.2061	0.2551	5.44	0.2104	0.2569	5.72
R	1	0.5174	0.3239	4.62	0.5180	0.3219	4.52
	2	0.5258	0.3228	4.38	0.5168	0.3215	4.58
	3	0.5264	0.3225	4.28	0.5201	0.3223	4.50
S	1	0.3351	0.3970	3.11	0.3343	0.3937	3.25
	2	0.3338	0.3930	3.22	0.3374	0.3930	3.22
	3	0.3334	0.3974	3.14	0.3361	0.3911	3.30
T	1	0.5029	0.4594	32.50	0.5018	0.4607	32.48
	2	0.5022	0.4607	32.12	0.4997	0.4619	32.92
	3	0.5033	0.4602	32.43	0.4993	0.4620	32.82

TABLE VII

COLOR COORDINATES OF METAMERIC FADINGS*

Sample	Unexposed			Exposed		
	x	y	Y(%)	x	y	Y(%)
a	0.3592	0.3838	6.80	0.3574	0.3762	7.08
b	0.3617	0.3817	6.70	0.3656	0.3816	6.70
c	0.3582	0.3802	6.22	0.3502	0.3710	6.58
d	0.3540	0.3783	6.60	0.3524	0.3724	7.24
e	0.3558	0.3801	6.66	0.3567	0.3756	7.03
f	0.3625	0.3846	5.67	0.3667	0.3856	6.01
g	0.3574	0.3810	6.38	0.3636	0.3792	6.78
h	0.3572	0.3861	6.20	0.3582	0.3806	6.73
i	0.3522	0.3918	6.44	0.3540	0.3888	7.20
j	0.3569	0.3894	6.89	0.3602	0.3882	7.50
k	0.3594	0.3848	6.74	0.3595	0.3798	7.65
l	0.3547	0.3770	6.26	0.3575	0.3762	7.05
m	0.3564	0.3770	6.96	0.3625	0.3737	7.53
(Std) n	0.3568	0.3808	7.12	0.3646	0.3818	8.20

* x, y, and Y as given are the average of two readings.

CONCLUSION

In this paper certain information regarding visual fading test evaluation has been obtained in terms of colorimetric data. The following points are of interest:

1) This data may be utilized to evaluate the usefulness of a given "color-difference" formula.

2) It indicates the variability to be expected between observers.

3) The magnitude of the difference below which visual confusion for certain shades exists is defined.

4) In order to illustrate how the data may be used to evaluate a given color difference formula, the well-known Adams-Nickerson formula is employed. Certain difficulties and lack of correlation are made readily apparent.

5) An attempt to establish the equivalence of color difference between different regions of color space in terms of the particular formula employed reveals the magnitudes involved, but also points up the need for a greater number of observers.

6) The effect of metamerism on the consistency of observers has been studied with fourteen samples matching the same shade and eight observers each performing the test more than once.

It is concluded that since the variation encountered on these samples is significantly greater than that on the non-metameric matches, one must be concerned with this problem in light-test evaluations where the standard is dyed with a different formation than the submissions. The results of this paper point up the dubious value associated with attempting to refine instrumental methods to a greater degree than the precision implied by the variation involved. In other words, if visual confusion would exist between samples exhibiting a C D of 1.5 and 1.6 respectively, then specification to a greater degree is unwarranted. This thought, while generally well known, is advanced here because of a tendency in color work to lose sight of basic measurement practice.

Another point which this research emphasizes is that it would be rather poor judgment to employ the results of *one* light-test evaluation in cases of any economic importance. Further, strenuous arguments regarding test results may be statistically insignificant when the variation involved is considered and the appropriate significance test applied.

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Finishing Textiles——

WRINKLE-RESISTANT FINISH FOR CELLULOSIC FABRICS*

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It is postulated that wrinkle resistance in cellulosic fabrics is obtained with thermosetting resins of the melamine or urea formaldehyde type by increasing the elasticity of the building blocks of the fabrics, i e, the cellulosic fibers. This change in the fibers results in an increase in the elasticity of the yarns, which in turn brings about an increase in the elasticity of the fabric. It is postulated that the wrinkle resistance is primarily obtained by chemical reaction between the melamine or urea formaldehyde and the cellulose with the formation of cross links or bridges between adjacent cellulosic chains.

A wrinkle-resistant finish for cellulosic fabrics obtained with melamine resins using a newly developed accelerator is described. With this accelerator there is a reduction in the loss in tensile strength and yellowing of melamine-formaldehyde-treated cellulosic fabrics during chlorine bleaching. It also greatly improves the efficiency of the resin.

INTRODUCTION

WRINKLE resistance in wearing apparel is important to the appearance of the individual wearing the fabric. It is especially important with cellulosic fabrics, which inherently are prone to wrinkle, especially under conditions of high humidity. The rapid growth in the use of textile resins on cellulosic fabrics has been largely due to the improvement in wrinkle resistance brought about by these resin finishes. The importance of imparting wrinkle resistance to cellulosic fabrics is attested by the fact that hundreds of millions of yards of cellulosic fabrics have been treated with melamine-formaldehyde and urea-formaldehyde resins over the past few years. The volume of these resins used has continued to increase.

A review of the literature shows that the mechanism of wrinkle resistance has been studied by a number of people. Two of the best treatises of this subject have been those of Gagliardi and Gruntfest *(3)* and Hamburger, Platt and Morgan *(4)*.

These workers have proposed that there is a correlation between fiber and yarn elasticity and the wrinkle recovery of the fabric composed of these fibers and yarns. One might also expect that there would be a correlation between fabric elasticity and wrinkle resistance. However, nothing could be found in the literature on measurements of the elasticity of resin-treated fabrics at relatively low extensions to determine whether such data correlate with the wrinkle resistance of the fabrics. It was felt that such a study would be of great importance for a better understanding of the mechanism of the wrinkle resistance of fabrics. In fact, it was felt most desirable to obtain the physical properties including the elasticity of 1) fabrics, 2) the yarns making up the fabrics, and 3) fibers of which the yarn is constructed. It was also considered important that wrinkle-resistance measurements of the fabrics be made as well as appearance wear tests to determine if a correlation existed between these sets of measurements. In addition, it was felt that other physical properties, such as stiffness, tear strength, etc, should be made.

* Presented in the Empire Room of the Atlanta Biltmore Hotel in Atlanta, Ga, on Thursday morning, Sept 16, 1954, before the Symposium on Finishing Textiles.

TABLE I
WEAR TESTS

Treatment	Rating Numbers	95% Confidence Limits
Before Washing		
MF + S-EA Copolymer	10.0	±0.1
MF	8.7	±0.2
S-EA Copolymer	5.1	±0.3
Control	3.5	±0.3
LAC of MF	2.3	±0.2
PVA	2.4	±0.2
After 1st Washing		
MF + S-EA Copolymer	8.5	±0.2
MF	8.9	±0.3
S-EA Copolymer	3.5	±0.2
Control	2.7	±0.3
LAC o MF	2.1	±0.1
PVA	2.4	±0.3
After 2nd Washing		
MF + S-EA Copolymer	7.0	±0.2
MF	7.0	±0.2
S-EA Copolymer	2.8	±0.3
Control	2.0	±0.0

EXPERIMENTAL

COTTON STUDIES——Consequently, measurements were made of untreated and various resin-treated samples of an 80 x 80 cotton fabric and yarns taken from the fabric. No single-fiber measurements were made on the cotton because of the large number of samples needed to obtain a degree of precision that is meaningful. However, elasticity measurements were obtained on untreated and resin-treated rayon-filament fabric, the yarns going into this fabric and the fibers of which the yarns were composed.

Several resin finishes on cotton with a wide range of properties were studied. These finishes included 1) 8% solids of a methylated melamine-formaldehyde monomer, 2) 8% solids of an acid colloid made from the same melamine-formaldehyde monomer, 3) 5% solids of an aqueous dispersion of a copolymer of styrene and ethyl acrylate, 4) 8% solids of the melamine-formaldehyde monomer plus 2.4% solids of the styrene/ethyl-acrylate copolymer and 5) 5% solids of an aqueous dispersion of a polyvinyl acetate. Along with these resin treatments was included the 80 x 80 cotton fabric processed with distilled water as a control.

The monomeric melamine-formaldehyde treatment was chosen as a typical melamine-formaldehyde, wrinkle-resistant finish for cotton fabric. Dye-staining tests have shown that applications of this monomeric melamine formaldehyde with an acid-forming catalyst deposit the melamine formaldehyde inside the cotton fiber.

The acid-colloid treatment was primarily chosen in this study because the stiff finish produced gives some degree of "muss" resistance. This fabric does not readily fold into wrinkles but has little or no ability to recover from wrinkling. The acid colloid was prepared by adding lactic acid to an aqueous solution of the monomeric melamine formaldehyde. After be-

TABLE II

COTTON FABRIC WARP ELASTICITY AND EXTENSION

Wear Rating	Treatment	% Elasticity	95% Confidence Limits	% Extension at Break	95% Confidence Limits
10.0	MF + S-EA Copolymer	94.8	±1.0	9.0	±0.6
8.7	MF	88.2	±1.1	8.2	±0.3
5.1	S-EA Copolymer	84.6	±1.3	11.6	±1.3
3.5	Control	72.8	±0.8	11.7	±0.6
2.3	LAC of MF	68.2	±0.8	10.4	±0.7
2.4	PVA	58.2	±0.7	11.5	±0.5

ing aged several hours, the melamine formaldehyde reached a stabilized state of partical polymerization. The acid colloid was found in this case and had also previously been found by dye-staining techniques *(2)* to be deposited on the outer surface of the cotton fiber.

The styrene/ethyl-acrylate finish was chosen because it is a thermoplastic resin with elastomeric properties and imparts a small degree of wrinkle resistance to a cellulosic fabric. It has a molecular weight of 20-40,000 and thus is too large to enter the interior of the cotton fiber. Consequently, it is deposited on the surface of the fiber. The combination finish of a melamine-formaldehyde resin and a styrene/ethyl-acrylate copolymer was included because this composition gives somewhat higher wrinkle resistance than a melamine-formaldehyde resin alone. The polyvinyl acetate dispersion was chosen because it imparts a stiff finish but no wrinkle resistance. It also has a molecular weight of 20-40,000 and is deposited on the surface of the fiber.

For control purposes, the 80 x 80 cotton fabric was water-processed and evaluated in all of the tests along with the resin-treated fabrics. Laboratory coats of the wrap-around style were made from each of the five treated fabrics along with the control fabric. One set of each of the laboratory coats was worn by the personnel of one laboratory and rated individually by personnel of that laboratory, whereas the other set was worn and also rated by the personnel of a separate laboratory. The final rating given each finish was the average of the two wear tests. Evaluation of the laboratory coats was based on the appearance of the coats from a wrinkling standpoint after they had been worn. Evaluations were made after the coats were worn each day in the laboratory and again the following morning after hanging on coat hangers the previous night, the average of the two observations being the final rating. The coats were worn for eight days and then washed in a Bendix automatic washer in a running suds with soap and soda ash through the normal cycle. The coats were washed, worn again for eight days and then washed a second time. After the second wash, the lactic-acid-colloid and polyvinyl-acetate treated coats were removed from the test because of their poor appearance from the standpoint of wrinkle resistance. The remaining coats were worn for an additional eight wearing days. The coats were rated on a scale of 5,4,3,2,1 varying in that order from good to poor. Since there were two coats made from each treated fabric, the final rating was obtained by adding together the ratings of each coat. Therefore, the best treatment had a rating number of 10 and the worst, 2. Table I gives the ratings along with the 95% confidence limits calculated for each set of data. The following abbreviations are used:

MF	— melamine formaldehyde
S-EA Copolymer	— styrene/ethyl acrylate copolymer
Control	— water-processed untreated fabric
LAC of MF	— lactic acid colloid of melamine formaldehyde
PVA	— polyvinyl acetate

As can be seen from the data of Table I, the combination of melamine formaldehyde and styrene/ethyl-acrylate copolymer gave the best wrinkle resistance in the wear tests. The second best was the melamine-formaldehyde-treated fabric. The styrene/ethyl-acrylate copolymer gave a small but real improvement in wrinkle resistance over that of the untreated fabric. The lactic-acid colloid of the melamine formaldehyde and the polyvinyl acetate both gave a fabric with poorer wrinkle resistance than the untreated control fabric. On a purely numerical basis, the initial difference between the lactic-acid colloid of melamine formaldehyde and polyvinyl acetate could not be distinguished. The polyvinyl - acetate - treated fabric showed large wrinkles, whereas the fabric treated with lactic-acid colloid of melamine formaldehyde showed a relatively larger number of considerably smaller wrinkles. This difference made it difficult for the observers to rank these two finishes properly.

Fabric elasticities were measured with an Instron tester on the same fabrics at 5% extension, which was approximately half of the ultimate extension at break of the treated fabrics. The elasticity tests were made as follows: One-inch strips were cut and conditioned at 70°F and 65% relative humidity. The elasticity measurements were made on the test samples with an Instron tester under the same humidity and temperature conditions. The gage length on the Instron tester was 4 inches, and the rate of extension was 50% per minute. The sample was stretched to 5 percent and was immediately relaxed at the same rate with the automatic extension cycle device. After a five-minute rest, the sample was restretched through a second cycle. The amount of unrecovered deformation is called the *permanent set* of the sample. The remaining part is *recoverable deformation* (both immediate and delayed) and is a measure of the sample's elasticity under the test conditions. The elasticity values were obtained from the following formula: percent elasticity equals amount of extension recovered after five minutes divided by the total extension multiplied by 100.

Table II gives a comparison of the wear-test ratings of the treated fabrics, the percent elasticity and percent extension at break in the warp direction. As can be seen, the percent-elasticity measurements correlate very well with the wear-test rating, the fabric with the highest elastic recovery having the best rating in the wear tests. It should be pointed out that,

TABLE III

COTTON-WARP-YARN PROPERTIES

Treatment	% Elasticity	95% Confidence Limits	% Extension at Break	95% Confidence Limits
MF + S-EA Copolymer	93.1	±0.8	7.8	±0.3
MF	93.6	±1.3	7.3	±0.3
S-EA Copolymer	85.6	±1.2	8.6	±0.6
Control	85	±0.9	8.7	±0.8
LAC of MF	71.5	±1.1	8.2	±0.2
PVA	66	±1.3	7.7	±0.6

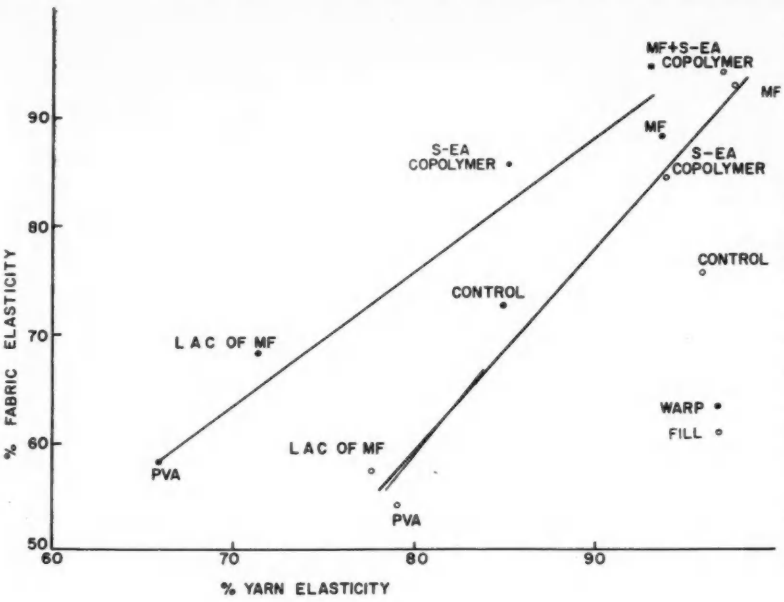

Figure 1
Cotton Elasticities — Fabric vs Yarn

in the case of the two fabrics with the highest wrinkle resistance, there is a decrease in the percent extension at break of the treated fabric. In other words, these finishes reduce the ability of the fabric to elongate under stress.

Elasticity measurements were made on yarns taken from the untreated and treated 80 x 80 cotton fabrics. The elasticity of the cotton warp yarn as well as the extension at break are given in Table III.

As can be seen by a comparison of these data with those given in Table II, the correlation between yarn elasticities and fabric elasticities is good. The two noticeable places where the correlation is not excellent is in the comparison of the control and the styrene/ethyl-acrylate-copolymer-treated yarns and between the melamine formaldehyde and styrene-ethyl-acrylate plus the melamine-formaldehyde treatments. In these two cases, the yarn elasticities are essentially equal, whereas the fabric elasticities are not equal.

The differences in the extensions at break of the various yarns are not so pronounced as is the case with the fabrics.

The correlation between the yarn and fabric elasticities is perhaps best seen by Figure 1, where a plot of the elasticity of the yarn versus the elasticity of the fabric is given for both the warp and fill directions.

Table IV gives the wrinkle recovery and the elasticity in the warp direction compared with the wear-test rating of the cotton fabrics.

The correlation between present wrinkle recovery and percent elasticity is very good. The percent-elasticity measurements

TABLE IV
COMPARISON OF WARP WRINKLE RECOVERY WITH ELASTICITY

Wear Rating	*Treatment*	*% Wrinkle Recovery*	*95% Confidence Limits*	*% Elasticity*	*95% Confidence Limits*
10.0	MF + S-EA Copolymer	78.8	±1.7	94.8	±1.0
8.7	MF	72.2	±2.1	88.2	±1.1
5.1	S-EA Copolymer	50.0	±2.5	84.6	±1.3
3.5	Control	46.1	±1.7	72.8	±0.8
2.3	LAC of MF	36.7	±2.9	68.2	±0.7
2.4	PVA	32.8	±1.7	58.2	±0.7

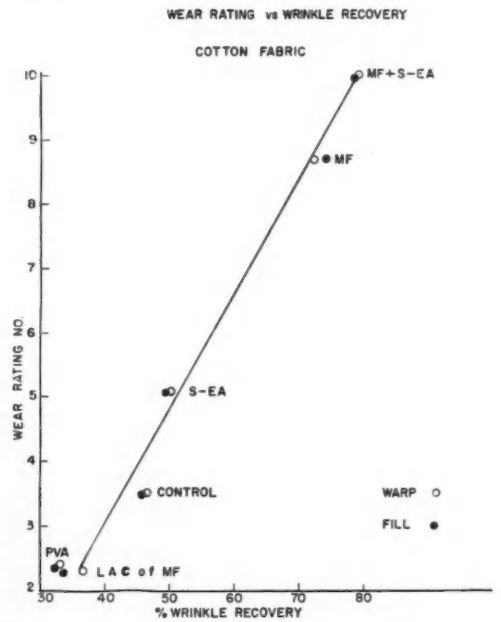

Figure 2
Wear Rating vs Wrinkle Recovery

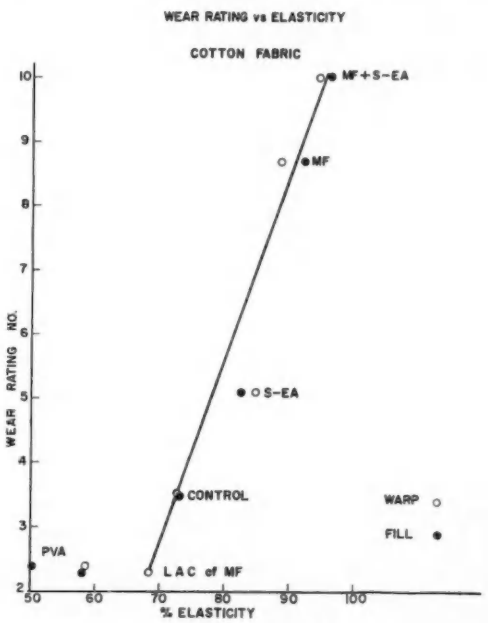

Figure 3
Wear Rating vs Wrinkle Recovery

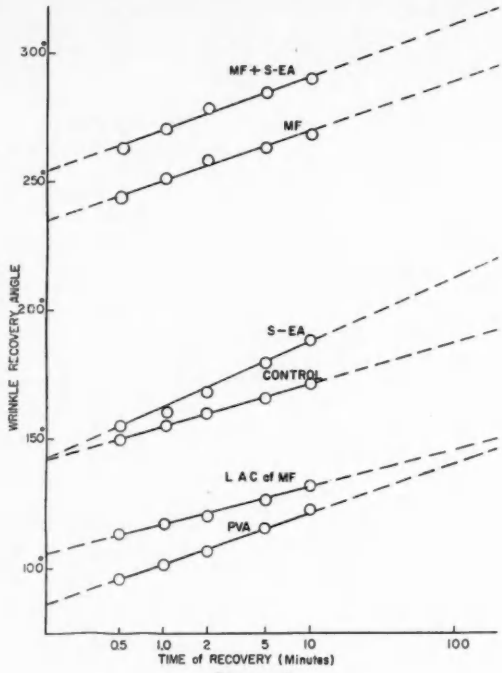

Figure 4
Wrinkle Recovery vs Time

made on the Instron tester are more precise than the percent wrinkle recovery determined from the Monsanto-wrinkle-reecovery tests as determined by the 95-percent confidence limits of the two sets of measurements.

Plots of wear-rating number with wrinkle recovery and elasticity, respectively are given in Figures 2 and 3.

The concept of obtaining greater wrinkle recovery with increased fabric elasticity has much wider implications than the treatment of cellulosic fabrics with resins. *It indicates that to obtain optimum wrinkle resistance the construction of a fabric of any fiber should be designed to obtain the greatest fabric elasticity.*

In addition to the wrinkle-recovery measurements made according to the standard procedure with the wrinkle-recovery tester, measurements were made on each fabric at time intervals from 0.5 to 10 minutes. The logarithm of time of recovery in minutes is plotted versus the wrinkle-recovery angle (warp plus fill degrees) in Figure 4. Straight lines were obtained in all cases with these plots of the logarithm of time versus wrinkle-recovery angle. The rate of recovery of the styrene-ethyl-acrylate-copolymer-treated fabric is greater than that of the untreated. This phenonomen explains why the styrene-ethyl-acrylate-copolymer-treated laboratory coats showed better appearance after hanging overnight than the untreated even though the five-minute wrinkle-recovery values are not far different. In the time of wrinkling of five minutes normally used in this test, misleading results may be obtained in comparing fabrics of different rates of wrinkle recovery.

Stiffness measurements were made with a Pierce *(6)* stiffnes tester. These measurements are given in Table V.

TABLE V
PIERCE STIFFNESS MEASUREMENTS

Wear Rating	*Treatment*	*Stiffness in inches*	*95% Confidence Limits*
10.0	MF + S-EA Copolymer	1.8	±0.1
8.7	MF	1.7	±0.1
5.1	S-EA Copolymer	1.8	±0.1
3.5	Control	1.6	±0.1
2.3	LAC of MF	4.1	±0.2
2.4	PVA	4.3	±0.1

There is no appreciable difference in stiffness ratings between the three finishes with the greatest wrinkle resistance and the control fabric. However, the two poorest wrinkle-resistant finishes have much higher stiffness than the other fabrics. These data show that the wrinkle resistance in the case of the finishes studied is not primarily due to increased stiffness. The lack of correlation between stiffness and wear-test results is important. *It shows that the ability of a fabric to recover from creasing is more important than its ability to resist creasing.*

RAYON STUDIES——A study similar to that carried out on cotton was made with rayon. Filament-rayon fabric (2 x 1 twill weave of 150/40 yarn), furnished through the courtesy of the American Viscose Company, was treated with both melamine and urea formaldehyde, and physical measurements were made on the treated fabrics. The melamine formaldehyde was the monomeric methylated product used previously to treat the cotton fabric, while the urea formaldehyde was essentially a mixture of monomeric mono- and dimethylol urea. In addition, yarns from which the filament fabrics were made were likewise treated. Physical measurements were made on these yarns and on fibers taken from the treated yarns. A water-processed control was also measured in all cases.

Wrinkle - recovery, breaking - strength, and percent-extension-at-break measurements were made on the rayon fabric. These data are given along with the elasticity measurements in the warp direction in Table VI.

The percent elasticity and wrinkle recovery of the urea-formaldehyde-treated rayon are somewhat higher than those of the melamine-formaldehyde but twice as much solids on the fabric was used. From the above data it can be seen that there is good correlation between percent elasticity and wrinkle recovery. As the percent elasticity increased, the percent extension at break decreased, as was the case with the cotton fabric.

Filament-rayon yarn similar to that used in weaving the rayon fabric was also treated with melamine and urea formaldehyde. Physical measurements of the yarn are given in Table VII.

The percent elasticity of the 15%-solids-urea-formaldehyde-treated yarn was greater than that of the 7.5%-solids-melamine-formaldehyde-treated yarn, which in turn was greater than that of the water-processed yarn. The percent extension at break decreased as the percent elasticity increased. This general relationship is similar to that shown for the rayon fabric.

The physical properties of rayon fibers taken from the yarn are given in Table VIII. As can be seen, the change in elasticity of the fibers with treatment is analogous to that obtained on the yarn. It will be noted that, as the elasticity increased, the percent extension at break of the rayon fibers decreased in a manner similar to that of the yarn.

It is interesting to note that there is good correlation among the elasticity and extension-at-break values of the rayon fabric, yarn, and fiber. The same relative increase in the elasticity of the fibers with melamine- and urea-formaldehyde treatment was present in the case of the yarn

and of the fabric. Also, the same relative decrease in the percent extension at break of the fibers was also present in the case of the yarn and of the fabric. The correlation in breaking-strength data is not so good as in the case of the elasticity and extension-at-break values. The excellent correlation between the elasticities of the rayon fabric, yarn, and fiber indicates that the increase in elasticity of the building blocks of the fabric, ie, the fibers, by the melamine- and urea-formaldehyde treatment is carried through the yarn to the fabric. This increase in the elasticity of the fabric in turn results in increased wrinkle resistance.

DISCUSSION OF RESIN MECHANISMS

The literature of the mechanism by which melamine- and urea-formaldehyde monomers chemically impart wrinkle resistance to cellulosic fibers is controversial. Since it is well known that urea- or melamine-formaldehyde monomers can polymerize to form a resin, one of the earliest theories advanced was that the resin reacted with itself when applied to a cellulosic fiber. This mechanism is still believed by some as evidenced by an article published as recently as May of 1954 *(5)* from which I quote, "others believe that . . . the resin formers fill the pores and channels of the fibers with insoluble resin that, to a considerable extent, may be bonded to the cellulose by physical rather than by chemical linkages." It has been proposed by some who think that the resin polymerizes wihin the cellulosic fibers that hydrogen bonding and Van der Wall's forces between the polymerized resin and the cellulose are responsible for imparting wrinkle resistance to cellulosic fabrics. Contrary to this school of thought on the mechanism has been the proposal that the monomeric melamine and urea formaldehyde chemically react within the cellulosic fiber to cross-link between adjacent cellulosic chains. Probably the first to propose this theory were Cameron and Morton in 1948 *(1)*. These authors advanced the hypothesis that wrinkle-resistant finishes for rayon are obtained by thermosetting types of resins by cross bonding. Gagliardi and Gruntfest in 1950 *(3)* likewise proposed this same theory.

Infrared spectrophotometric data of cellophane films treated with monomeric melamine formaldehyde suggest that chemical reaction of the melamine formaldehyde with the cellulose takes place. Although it is quite likely that resin formation does take place within the cellulosic fiber, it is postulated that wrinkle resistance is primarily obtained by chemical reaction between resin and cellulose.

A NEW ACCELERATOR

It is further postulated that the amount of resin that reacts with itself and that which reacts with cellulose can be controlled within limits by the type of accelerator used. Recently a new accelerator called Aerotex* Accelerator MX has been developed, which it is believed tends to favor the reaction of resin with cellulose. It improves the wrinkle resistance of cellulosic fabrics obtained with melamine-formaldehyde resins. In addition, it reduces the yellowing and the loss in tensile strength of melamine-formaldehyde-resin-treated fabrics when chlorine-bleached.

Aerotex Accelerator MX is also a good catalyst for urea-formaldehyde resins. However, it is most effective with melamine resins, probably because it chemically combines with these latter resins.

The physical properties of this accelerator are given in Table IX.

Extensive mill trials of wrinkle-resistant as well as embossed and glazed finishes on cotton have shown that melamine resins catalyzed with Aerotex Accelerator MX give greater wrinkle and chlorine resistance than with the usual type of catalyst. Excellent shrinkage control and wrinkle resistance on rayon have also been obtained with melamine resins catalyzed with Aerotex Accelerator MX. Examples of finishes illustrating these points are given in Tables X, XI and XII.

Table X gives a comparison of results obtained on a mill run of an embossed 80 x 92 white cotton dress fabric with melamine resins catalyzed with Aerotex

* Registered trade-mark.

TABLE VI
RAYON FABRIC—WARP PROPERTIES

Treatment	% Elasticity	95% Confidence Limits	Wrinkle Recovery Angle	95% Confidence Limits	% Extension at Break	95% Confidence Limits	Breaking Strength lb	95% Confidence Limits
15% UF	73	±0.7	106°	±3	13	±1.0	86	±4.2
7.5% MF	65	±1.9	88	±4	16	±0.9	83	±4.6
Control	56	±1.5	79	±4	19	±1.5	76	±4.9

TABLE VII
PHYSICAL PROPERTIES OF RAYON YARN

Treatment	% Elasticity	95% Confidence Limits	% Extension at Break	95% Confidence Limits	Breaking Strength g	95% Confidence Limits
15% UF	89.0	±1.0	4.2	±0.7	306	±19
7.5% MF	76.7	±1.2	7.5	±0.8	267	±21
Control	51.8	±0.4	16.8	±0.6	334	± 8

TABLE VIII
PHYSICAL PROPERTIES OF RAYON FIBER

Treatment	% Elasticity	95% Confidence Limits	% Extension at Break	95% Confidence Limits	Breaking Strength g/d	95% Confidence Limits
15% UF	80.2	±1.3	10.8	±0.5	2.49	±0.2
7.5% MF	64.5	±2.3	14.2	±2.0	2.07	±0.1
Control	48.8	±3.6	23.9	±1.1	2.09	±0.1

TABLE IX
PHYSICAL PROPERTIES OF ACCELERATOR MX

Appearance:	Water-white, free-flowing liquid
Lbs per gallon:	10.6
pH (77°F or 25°C)	5.5-6.0
Freezing point:	10°F
Storage stability:	Indefinite over a wide temperature range; unaffected by freezing

TABLE X
COMPARISON OF AEROTEX ACCELERATOR MX WITH ORGANIC ACCELERATOR

Accelerator	% Loss in Strength AATCC Accelerated Chlorine-Retention Test	Color After Embossing	Durability of Pattern	Wrinkle Recovery (Warp + Fill)
MX	2	White	Excellent	286°
Organic type	51	Slight yellow cast	Good	250°

TABLE XI
PROPERTIES OF RAYON FABRIC

	Wrinkle Recovery (Warp + Fill)	Washing at 212°F with Soap: % Shrinkage 1 Wash Warp	1 Wash Fill	10 Washes Warp	10 Washes Fill	Durability of Hand through 10 Washes
Melamine resin with 7.5% solids + Aerotex Accelerator MX	243°	1	0	+0.5	+3	good
Untreated	178°	7	2.5	17	6.5	—

TABLE XII
PROPERTIES OF TREATED COTTON FABRIC

Finish Applied	Wrinkle Recovery (Warp + Fill) Initial	Wrinkle Recovery (Warp + Fill) Washed	% loss in Strength, AATCC Accelerated Chlorine-Retention Test
melamine resin with 3.5% solids plus Aerotex Accelerator MX	259°	265°	0
Melamine resin with 3.5% solids plus organic accelerator	220°	202°	33
Melamine resin with 7% solids plus organic accelerator	263°	248°	54

Accelerator MX and an organic accelerator, respectively. These results show that an embossed finish obtained with melamine resins catalyzed with Aerotex Accelerator MX has better resistance to chlorine retention, color, wrinkle recovery and durability of pattern than those obtained with an organic type of accelerator.

Melamine resins applied to rayon gabardine with Aerotex Accelerator MX give excellent shrinkage control and good durability of hand after repeated high-temperature washes, as shown by Table XI.

With the increased resin efficiency obtained with melamine resins and Aerotex Accelerator MX equal wrinkle recovery and durability of finish can be obtained with less resin as shown by the data obtained on 80 x 80 cotton fabric given in Table XII.

In the application of the resin the use of forty percent by weight of Aerotex Accelerator MX on the weight of the resin solids is recommended for optimum results.

Resin pad baths with Aerotex Accelerator MX usually have a pH of about 7 and exhibit excellent stability. The treated fabrics have a neutral or nearly neutral pH. Aerotex Accelerator MX is odorless and in itself will not produce unpleasant fish-like odors when used with thermosetting resins. Fabrics are padded and dried in the conventional manner. Curing may be done in loop dryers, cure boxes or other types of curing equipment at temperatures normally used with the conventional catalysts. Although good results may be obtained by curing at temperatures as low as 300°F, higher curing temperatures will give optimum resistance to chlorine retention. Of course, overcuring should be avoided, as with other accelerators.

Many direct-dyed fabrics bleed and thus change shade when padded through resin baths containing conventional catalysts. The use of Aerotex Accelerator MX will reduce the bleeding of direct dyes to a minimum and in most cases will eliminate bleeding altogther. This accelerator generally has no effect on the light fastness of resin-treated dyed fabrics. Resin treatment with Aerotex Accelerator MX produces the usual improvement in the wash fastness of dyed fabrics.

SUMMARY

A mechanism for explaining how wrinkle resistance is obtained with cellulosic fabrics by means of melamine and urea formaldehyde has been advanced. It is postulated that the attainment of wrinkle resistance is by an increase in the elasticity of the fabrics treated with these products. It is proposed that the increase in the elasticity of the fabric is obtained by an increase in the elasticity of the fibers, which is carried through to the yarns and finally to the fabric.

A new accelerator, Aerotex Accelerator MX, has been described which has the following properties: It

1) provides pad baths with improved stability
2) reduces the chance of developing unpleasant odors on treated goods
3) provides treated goods that are neutral
4) reduces the tendency of direct-dyed goods to bleed in the resin pad bath

With melamine-formaldehyde resins, it

1) increases the chlorine resistance
2) improves the wrinkle resistance
3) increases the shrinkage control
4) gives greater durability of pattern to embossed fabrics
5) gives whiter undyed fabrics

ACKNOWLEDGMENT

The author is indebted to the American Viscose Company for furnishing the rayon fabric used in this study. He wishes to express his appreciation to his many associates who contributed to this work and especially to the following: J H Dusenbury, L A Fluck, R H Kienle, E E Lineken, A L Logan, L J Moretti, W N Nakajima, P B Roth, and S S Slowata.

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Membership Applications

(Concluded from Page P882)

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CORPORATE

Moreland Chemical Company

APPLICATION FOR TRANSFER TO SENIOR MEMBERSHIP

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John A Davis
Manuel A DaSilva
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Elias M Haddad
Vernon C Smith

HISTORICAL NOTES ON THE WET-PROCESSING INDUSTRY

VII—Le Doyen des Etudiants de France
Michel Eugene Chevreul (1786-1889)

SIDNEY M EDELSTEIN

Dexter Chemical Corporation

This is the seventh in a series of historical articles which the textile chemist and colorist will find of interest.

The author, a prominent science historian, is the founder of an outstanding collection of great works, documents and letters in the history of chemistry and related sciences.

Articles and illustrations in this series are from the author's library.

ALMOST every week one reads in the press that one John Jones or Mary Smith or Abner Hasenfeffer has passed his or her 100th birthday. These centenarians give out interviews, have their pictures taken and generally have a fine time. Usually their one claim to fame is their longevity. One almost gets the idea that real accomplishment in this world cannot go hand-in-hand with a long life.

The life of Michel Eugene Chevreul belies this thought. Chevreul lived to be almost 103; he published over a thousand papers and books under 540 heads and laid the basis for a scientific textile-chemical industry, and a scientific dyeing industry. He discovered the laws of color contrast and invented the system which is used today in modified form for describing colors. His work on color fathered the impressionist school of modern art and his work in organic chemical analysis laid the foundation for the whole system of theoretical and industrial organic chemistry.

Figure 1
Medal presented to Chevreul by students of France on his 100th birthday. Obverse and reverse.

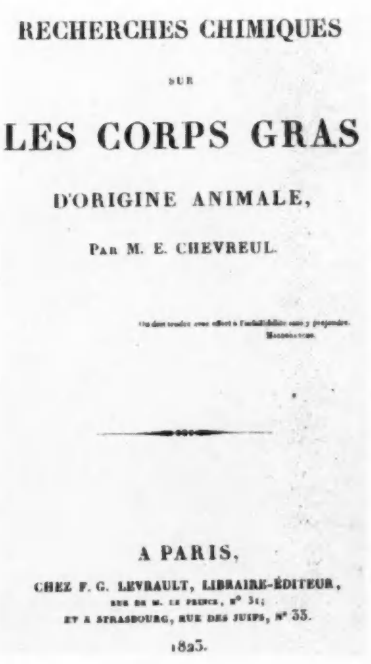
On the occasion of Chevreul's 100th birthday in 1886 a great celebration was held in Paris and among the many honors given to him at that time was a medal paid for by the young students of France. (See Fig 1). This beautiful medal is interesting to us as textile chemists and dyers not only because of the great respect shown to Chevreul, but particularly because there are represented on one side of the medal the four greatest works of Chevreul. These are, "Corps Gras," (fats), "Contraste Simultane des Couleurs," (simultaneous contrast of colors), "Chemie Appliquee a la Teinture," (the applications of chemistry to dyeing) and "Vision des Couleurs," (color vision). In effect one might feel that, on this occasion, a great country was paying its respects not only to a great scientist but to a great industry . . . the textile industry.

Chevreul was born on August 31, 1786, in Angers, France, to Etienette Magdeleine and Michel Chevreul, doctor of medicine and master surgeon. It was once remarked by Ostwald that Chevreul must have had a premonition of long life because of the rate at which he carried on his research, and besides, his father died at 91 and his mother at 93.

Chevreul's boyhood witnessed some of the greatest and most terrible events in history — the French Revolution and the Reign of Terror. In 1794, when Chevreul was eight years old, a guillotine was set up permanently near his home and he undoubtedly saw the murder of innocent women, children and old men, some of which were guilty and some of which were chosen to satisfy private hatreds. Young Chevreul, however, had a chance to observe bravery and respect for humanity within his own home, when the "representatives of the people" decided to expose the heads of the Vendeans killed during the siege of Angers. Chevreul's father was ordered to perform the decapitations, but, at the risk of his life, refused.

When Chevreul was old enough for school he was sent to a private teacher as the high schools and colleges of the country had been closed. A few years later, however, some of the schools of the country had been opened and Chevreul enrolled at the Ecole Central at Angers. He obtained a broad education, including science, and he received prizes in chemistry and physics as well as in Latin and Greek. While still a boy Chevreul, having decided to become a chemist, applied for admission to the laboratory of Vauquelin and Fourcroy, two of the outstanding chemists of the time. Vauquelin, quickly realizing the brilliance of the young boy, allowed him to collaborate in his own work. Chevreul undoubtedly had some part in Vauquelin's discovery of chromium.

In 1813 Chevreul published the first of seven papers on his study of fats. His work on fats, which was carried on between 1813 and 1818, completely revolutionized the chemist's ideas concerning soaps, fats and oils. The results of this work were systematized and published as a book of 500 pages under the title of


RECHERCHES CHIMIQUES

SUR

LES CORPS GRAS

D'ORIGINE ANIMALE,

PAR M. E. CHEVREUL.

A PARIS,

CHEZ F. G. LEVRAULT, LIBRAIRE-ÉDITEUR,

ET A STRASBOURG, RUE DES JUIFS, N° 33.

1823.

Figure 2
Title page of Chevreul's great work on fats.

"Recherches Chimiques sur les Corps Gras d'Origine Animale." (Fig 2). Even today this book is considered as one of the great chemical classics of all times.

Even after the work of Lavoisier little was known about the materials which were called oils, greases, fats, etc. Scheele, in 1783, however, had isolated a sweet principle from oils which Chevreul later called glycerin. When Chevreul began his work on fats little more was known other than the fact that the fats contained hydrogen, carbon, and a little oxygen. Chevreul was the first to explain the process of soap formation and that fats are combinations of acids with glycerine. He discovered and isolated many of the fatty acids such as oleic, palmitic, stearic, caproic and capric. He discovered cetyl alcohol by saponifying spermaceti. He worked out the system which is still used today for separating in the laboratory the various fatty acids, and he used melting points as an important identifying characteristic of organic substances. Chevreul studied all types of fats, even those from man and wild and domesticated animals. Many of the words we use today for fatty substances were coined by Chevreul who often used names to indicate the source of the material, as for example butyric acid (butter), and caproic acid (goat).

Chevreul showed that all natural fats are mixtures of just a few individual chemical substances. He looked upon soaps as salts and considered saponification to be a simple reaction in which the inorganic base took the place of anhydrous glycerine, the latter becoming glycerine as we know it by taking up water in the reaction. These fundamental ideas enabled the chemist to immediately understand the chemistry of fats and fat reactions because of the analogy to inorganic reactions which were well understood.

Figure 3
Chevreul just after his appointment as director of dyeing at Gobelins (Age 39).

While Chevreul's first paper concerned with dyestuffs was published in 1807 when he was 21 years old, he did not begin a serious devotion to dyeing and colors until his appointment as director of dyeing at the National Tapestry Works of Gobelins and of the carpet factory of Savonnerie in 1824. (Fig 3).

He quickly found that the work at these great factories was being carried on with little thought for scientific method and with a minimum of knowledge concerning the chemicals and raw materials used. Over a period of some six years Chevreul studied in detail the properties and the reactions of the various inorganic and organic chemicals used in dyeing. This culminated in the publication of "Lecons des Chimie Appliquee a la Teinture" in 1829 and 1830. This work was really a course in theoretical and practical chemistry for the dyer.

Almost as soon as Chevreul began his work at the Gobelins he was confronted with complaints concerning the color strength of the black yarns used to produce the shadows in some of the blue and violet draperies. Upon comparing yarns dyed at the Gobelins with those dyed black at some of the other famous establishments he could find no difference and as Chevreul put it, he quickly realized that the "lack of strength of the Gobelins' blacks was due to the effects of the colors of the dyed yarns which were placed next to it and which depended on the phenomena of color contrast." And he "quickly realized that as the director of dyeing he would have two distinct fields of work: one which concerned the part that chemistry could play in dyeing and the other, the effect of color in the broad physical sense."

The difficult field of color from the physical and psychological standpoint held Chevreul's interest almost to the end of his life. Chevreul's last paper, published in 1884, when he was 98 years old, was concerned with vision and its relation to color contrast.

While Chevreul presented some of his first work on color contrast before several scientific societies, the great impact of his work did not begin to take effect on the field of dyeing, painting, and art in general until the publication of his monu-

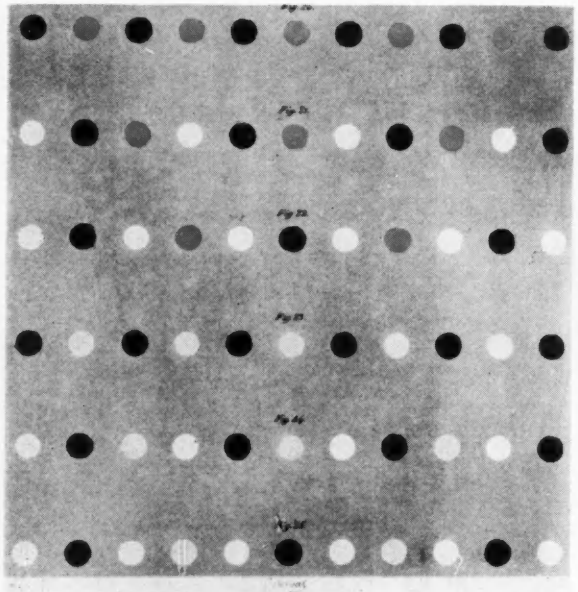


Figure 4
Hand colored plate signed by Chevreul from "Contraste Simultané des Couleurs" (1839).

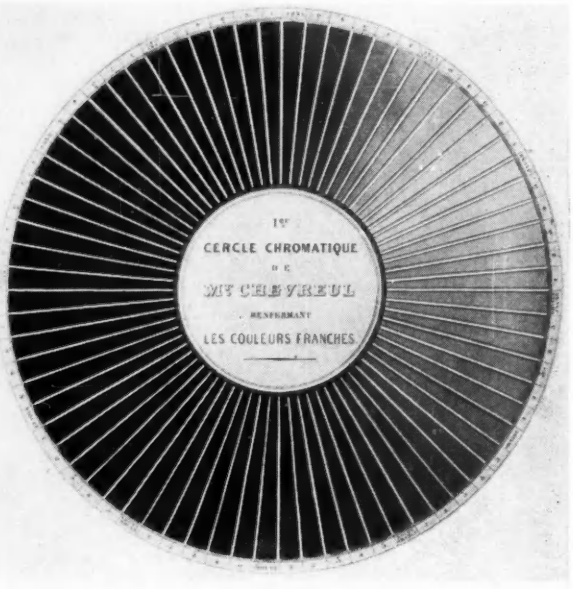


Figure 5
Illustration from Chevreul's "Colors and their application to the Industrial Arts with the Aid of Chromatic Circles". (1864).

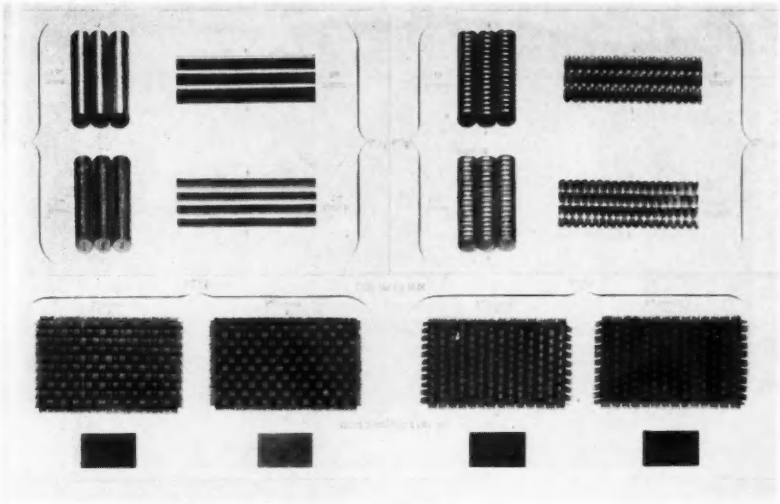


Figure 6
Illustration from work on "Optical Effects of Silk". (1846).

mental work entitled "De La Loi du Contraste Simultane des Couleurs," which was published in 1839. This book had seven-hundred-and-fifty pages and was accompanied by an atlas of forty pages. This atlas is of particular interest as each plate was hand colored and then personally checked and signed by Chevreul. This work is an example of Chevreul's concern with accuracy and detail. (See Fig 4). The main discoveries of Chevreul concerning "simultaneous contrast" may be summed up by the following points:

1) When two colored objects are placed next to each other, each one loses its own color and takes on a new color, which is due to the modification of its own color by the complimentary of that which is next to it.
2) Placing two colors of different tone next to each other lightens the tone of the darker and lowers that of the brighter.
3) If two adjacent colors are complimentary the shade of one cannot be modified by the complimentary of the other. The tones of both are heightened.

The work of Chevreul in both the chemistry and physics of color posed a third problem: How could colors be described with accuracy and on a basis which would satisfy the scientist? Chevreul accepted the challenge and he devised a universal system for defining colors. This system was published in 1864 in a folio volume replete with color plates. It is entitled "Colors and Their Application to the Industrial Arts with the Aid of Chromatic Circles." In this work Chevreul pointed out that the definition of all colored substances can be based on the colors red, yellow, blue, orange, green and violet, which can be modified in four ways:

1) by the addition of white,
2) by the addition of black,
3) by the addition of a certain color which can change the specific property without dulling, and
4) the addition of a certain color which can change the specific property by dulling.

Chevreul made use of graduated colored circles and a system of tone, scale and shade to fix and define any particular color. (See Fig 5). His system, although modified, is still the basis for most color-naming systems in use today.

In addition to the foregoing Chevreul made many other studies related to textiles and dyeing. He was a pioneer in studying the stability of dyed fabrics to heat, light, water, oxidation and other reactants. He studied the moisture regain of fibers at different humidities and examined the relationship of the composition of wool and its effect on dye affinity. Under the auspicies of the Chamber of Commerce of Lyon he studied the optical effects shown by various fabric constructions of silk and developed a theory for explaining these effects based on a system of parallel cylinders combined with his previous ideas of color contrast. (See Fig 6). Altogether he published six volumes related to dyeing and color and seventy separate articles.

During most of Chevreul's life he was also intimately connected with the Museum of Natural History in Paris as its director. An interesting sidelight on Chevreul's strength of character and patriotism occurred during the siege of Paris by the Germans in 1870-71. During the bombardment several shots landed in the garden of the Museum and demolished part of the greenhouse. On the next day Chevreul, who was then 85 years old, in great bitterness against the Germans insisted on presenting before the Academy of Science the following declaration:

— DECLARATION —

» The Garden of Medicinal Plants, founded at Paris by edict of Louis XIII, in January, 1626

» Became the Museum of Natural History by decree of the Convention of June 10, 1793

was bombarded,

» Under the reign of William 1st, King of Prussia, Count Bismark, Chancellor

» By the Prussian army, during the night on the 8th and 9th of January, 1871

» Till then, it had been respected by the national powers and foreign lands.

Signed
E Chevreul

Figure 7
Last portrait of Chevreul. Age 101

Immediately after this strong protest to the German ruler, the needless destruction gained wide publicity. Even this was not enough for Chevreul, and he insisted on enlisting in the national guard and taking his turn as sentry on the fortifications despite his 85 years.

Chevreul continued his vigorous scientific activity almost to his death on April 9, 1889, at the age of 102 years, seven months, and nine days. He was given a state funeral and buried in the cemetery at L'Hay. While many honors were heaped on the great man, and while there are several statues erected in his honor, his great contributions to chemistry, dyeing and the science of color will be his greatest monuments.

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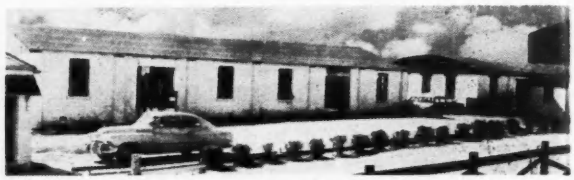
Polymer Industries, Inc, Springdale, Conn



Polymer Southern, Inc, Paris Station, Greenville, S C

• New Imperial Program Emphasizes Closer Consumer Contact

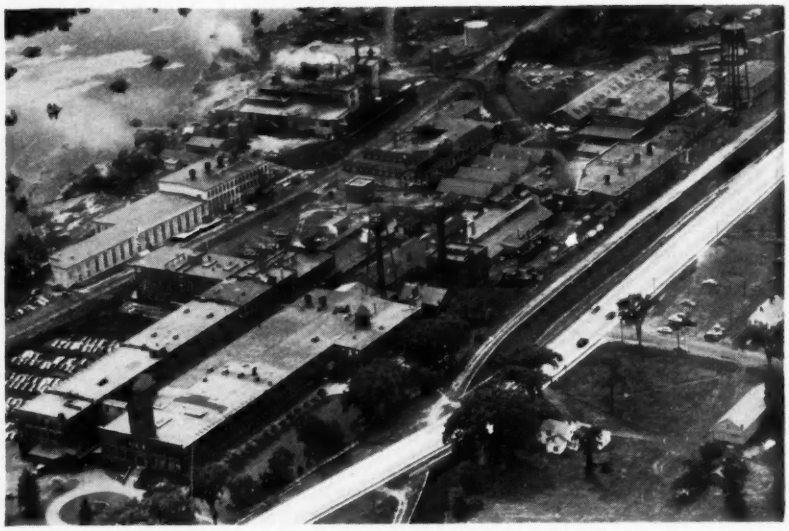
The recent appointment of Polymer Southern, Inc and Polymer Industries, Inc as exclusive selling agents for Imperial Paper and Color Corporation's aqueous pigment dyeing and printing systems for the textile wet-processing industries brings about closer sales and service contact between the manufacturer and consumer over a wide geographical area.

Polymer Southern, Inc, Paris Station, Greenville, S C, provides on-the-spot laboratory and warehouse facilities in the heart of the southern territory. Raymond T Clarke, president, is personally directing the southern program, assisted by his sales staff, which includes Richard E Rettew and S F Kowal.

Polymer Industries, Inc, Springdale, Conn, provides laboratory and warehouse facilities and service for New England, New York, Pennsylvania, Delaware, and Maryland. John W Ogletree, vice president, directs the northern program, assisted by H V Morrell and R E Buckler of his sales staff.

The Imperial line for textiles includes: Imprint, an aqueous pigment printing system in a wide range of shades; Impad, an aqueous pigment pad dyeing system; and Imperse, 20% aqueous pigment dispersions. Manufacture of these remains at Glens Falls, N Y, where Imperial operates what is reputed to be the world's largest chemical pigment color plant with complete research and development laboratories.

Approximately twenty years ago, Imperial initiated the use of pigment colors in conventional textile printing with dry Benzidine Yellow at the Arnold Print Works in North Adams, Mass. Imperial's research facilities, which have successfully developed the current Imperial line of aqueous pigment systems for textiles from that early beginning, continue to support the new venture in combination with the Polymer Companies. Imperial personnel are available for consultation and service calls. George F Jones, who is primarily responsible for the development and successful introduction of the present-day Imperial line, continues to conduct Imperial's textile research activities and travel with the Polymer representatives at regular intervals.



Imperial Paper and Color Corporation, Glens Falls, N Y

• Dow Purchases Versenes Inc

The purchase of Versenes Incorporated, Framingham, Mass, was announced recently by Leland I Doan, president of the Dow Chemical Company, Midland, Mich. All outstanding stock was acquired by Dow on December 1st in a cash transaction. According to Dr Doan, acquisition of the Massachusetts firm will enable Dow to further diversify its product line.

Versenes Inc, formerly Bersworth Chemical Company, has been engaged in the manufacture of the "Versenes", chelating agents which have the ability to selectively inactivate or combine with various metal ions.

Dr F C Bersworth, president of Versenes Inc, will become a Dow research consultant, and Frank Kottek, Versenes treasurer and general manager, will continue as production manager at Framingham, where manufacturing operations will be maintained.

* * * *

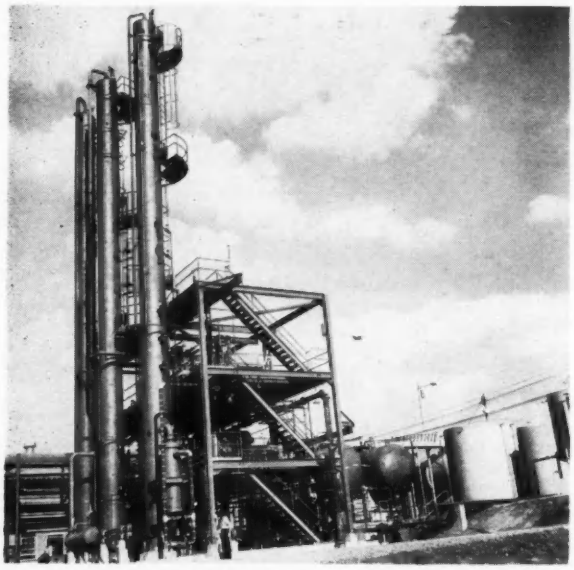
The Chas S Tanner Co, Southern agent for the "Versenes", has announced a new sales policy whereby all "Versenes" sales in the South will be handled by direct representatives of the Chas S Tanner Co. The Company advises that, effective immediately, all orders and inquiries will be processed and should be addressed to The Chas S Tanner Co, 2 East Washington St, Greenville, S C. The Company is transferring its office in the Liberty Life Building in Charlotte, N C, to 2300 North Brevard St. A complete stock of all the "Versenes" and Tanner chemicals is maintained at both Greenville and Charlotte.

• Buffalo Electro-Chemical Co Becomes Becco Chemical Div

Food Machinery and Chemical Corporation headquarters have announced that on January 1, 1955, its subsidiary, Buffalo Electro-Chemical Co, Inc, will be merged with the parent corporation and thereafter will operate as its Becco Chemical Division. The announcement was made by Ernest Hart, FMC executive vice president in charge of chemical divisions.

Buffalo Electro-Chemical, one of the foremost producers of hydrogen peroxide and other active oxygen compounds, was acquired by FMC in 1951 to complement the corporation's operations in diversified industrial chemicals. Sold under the trademark, Becco, the company's peroxygen chemicals are produced at its headquarters plant in Buffalo, New York, and its West Coast facilities in Vancouver, Washington.

Divisional operations will continue under the direct management of Max E Bretschger, FMC vice president in charge.



An installation for the production of chlorinated methane products at Solvay Process Division's Moundsville, W Va, plant.

• Chlorinated Methane Production Underway at Moundsville

Marking its entry into a new field of chlorinated organic chemicals, Solvay Process Division, Allied Chemical & Dye Corporation, recently started production of chlorinated methane products at Moundsville, W Va.

The new plant is said to be the most modern of its type in the industry. Products manufactured include methyl chloride, methylene chloride, chloroform and carbon tetrachloride.

Resembling a petroleum refinery in appearance, and designed with flexibility in mind, the plant can produce the four products mentioned in varying quantities to meet market demands, and is designed so that it could be readily expanded.

Moundsville was selected by Solvay as the site for its chloromethane plant because the chlorine could be readily supplied from Solvay's new chlorine plant at that location. Also, methane gas was available from the natural gas transmission lines running through Solvay's property. Further, studies indicated that Moundsville was strategically located with respect to industrial and consumer markets.

• M and W to Handle Hunter Expander Repairs in South

The James Hunter Machine Co, North Adams, Mass, is transferring the expander repair operations of its subsidiary, the Thomas Leyland Machinery Co, Inc to the Marshall and Williams Southern Corporation in Greensville.

Marshall and Williams has set up a complete stock of replacement parts and rubber sleeves to expedite the repair and recovering of expanders.

• Chemstrand Host to Dyestuff Representatives

A group of representatives from major dyestuff manufacturing companies were presented with the latest facts on the dyeing of Acrilan acrylic fiber and its blends last month at a two-day symposium conducted by The Chemstrand Corporation at its Research and Development Center in Decatur, Alabama.

Walter H Hindle, associate director of research for dyeing and finishing for Chemstrand, recently made initial disclosures concerning developments on new, simple, low cost methods of dyeing Acrilan-wool by entirely new principles. He referred to the one-bath, three-color effects involving Acrilan, acetate and rayon, and also Acrilan, rayon and wool combinations.

Representatives attending two-day symposium at The Chemstrand Corporation's Research and Development Center included: Front row (l to r): G A Heath, Geigy Co, Inc; C B Ordway, American Aniline Products, Inc; H E Millson, American Cyanamid Co; J A Zelek, Interchemical Corp; H A Weil, The Chemstrand Corp. **Second row**—G G Whytlaw, Textile Research Department, American Viscose Corp; W H Hindle, The Chemstrand Corp; A J McGregor, Arnold, Hoffman & Co, Inc; P L Meunier, E I du Pont de Nemours & Co, Inc. **Third row**—Charles Thompson, The Chemstrand Corp; W S Sollenberger, Textile Research Department, American Viscose Corp; J E Loughlin, National Aniline Division, Allied Chemical & Dye Corp; P J Choquette, General Dyestuff Co; D G Carmichael, Tennessee Eastman Co; M G Stern, Ciba Co, Inc; T H Guion, The Chemstrand Corp. **Fourth row**—E D Smith, The Chemstrand Corp; W C Carter, The Chemstrand Corp; and S Boddie, Sandoz Chemical Works, Inc.

• Arnold, Hoffman Opens Atlanta Office and Warehouse

Arnold, Hoffman & Co, Inc, Providence, R I, continues to increase its service to Southern customers through the opening of an Atlanta, Ga, office and warehouse.

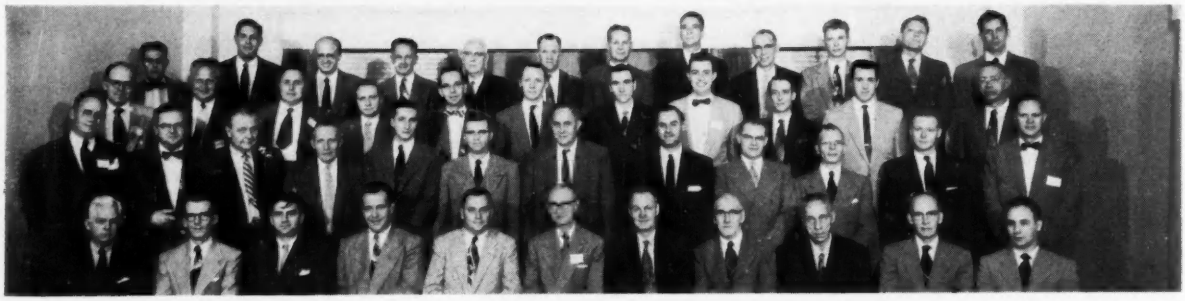
Dwight L Turner will head the new Atlanta branch, which will serve Tennessee, Georgia, Alabama, Florida, Mississippi, Louisiana, Arkansas and Texas. A sales service technical laboratory is scheduled to be placed in operation in Atlanta at a future date.

• "Hetron" Trade-Mark Registered

Hooker Electrochemical Co, Niagara Falls, N Y, has announced that the trademark "Hetron" has now been registered with the United States and Canadian trade-mark offices for its flame-resistant polyester resins. Polyester-glass fiber flat sheets, corrugated panels, and other laminates are now being made with Hetron by some of the major plastics fabricators. These fabricators in turn sell their products for industrial and consumer uses under their own trade names.

• Brush Tension Analyzer in Operation

The first unit of the new Brush Tension Analyzer is to be found in American Viscose Corporation's Textile Research Department. Developed by American Viscose in co-operation with the Brush Electronics Company, this analyzer reportedly will accurately test static and dynamic tensions from 1/10 to 400 grams in filamentary materials. Its use can be further expanded by the employment of certain accessory transducers.



DURING A MEETING of the Technical Association of the Pulp & Paper Industry, Eastern Division, Empire State Section held in Albany on October 21st, 86 members and guests were given a three-hour tour of the Albany Felt Company plant. The group was the largest ever to visit the Albany plant at one time. At the dinner meeting two AFC officials discussed quality controls and the use of chemical treatments and synthetics in paper machine felts.

• First Regional Water Pollution Abatement Workshop Held by MCA

The first of a proposed series of regional water pollution abatement workshops, held in Boston, Mass, on November 17, was attended by approximately 30 chemical industry representatives from fifteen chemical companies located in the New England states.

Chairman of the MCA-sponsored workshop was Bruce W Dickerson of the Hercules Powder Company, chairman of the MCA Water Pollution Abatement Committee. Mr Dickerson said he was "pleased and gratified" at the results of the first workshop and his committee will now begin considering future workshops in various parts of the country.

In addition to Mr Dickerson, the panel consisted of R W Hess, Allied Chemical & Dye Corporation, H L Jacobs, The DuPont Company, and K S Watson, General Electric Company.

The group, largely composed of plant operating men, discussed the day-to-day aspects of such topics as industrial pollution and effects, general methods of treatment, specific plant problems, such as disposal of sanitary sewage, municipal disposal versus plant treatment and the importance of conservation of water by recirculation.

Group cooperation with other plants on the same stream and industry-government cooperation were stressed by participants.

GLENN D JACKSON, JR, sales executive with North Carolina Finishing Co for the past six years, will serve as vice president and general manager of a new textile printing and dyeing firm, incorporated as the Nashua Finishing Co, Inc, Nashua, N H. The company has taken over the buildings and most of the finishing machinery of the Indian Head Mills, Nashua plant, and has purchased the entire printing department of Cheney Bros at Manchester, Conn, which they are moving to the Nashua Buildings. The new company plans to be in operation by April after installation of printing equipment and modernization of the present bleaching and dyeing machinery.

Mr Jackson is very active in AATCC affairs, currently serving as National Publicity Chairman, secretary of the Executive Committee on Research, and a member of the Colour Index Marketing Committee.

Following his graduation from MIT in 1927, Mr Jackson began his textile career with the old Slater Company of Webster, Mass. Prior to joining North Carolina Finishing, he held various technical and management positions with the United States Finishing Company in their Rhode Island and Connecticut plants. In 1945 he was a member of the textile team sent to Germany and Austria by the Office of the Quartermaster General to evaluate dyeing, printing and finishing techniques in those countries.

• PTI Alumni Mid-Winter Banquet

Leon P Brick, vice-president of Onyx Oil & Chemical Co, and president of the Alumni Association of Philadelphia Textile Institute, will serve as toastmaster of the 54th Annual Banquet of the Association to be held February 4, 1955 at the Warwick Hotel, Philadelphia. Guest speaker for the event will be Milton Harris, Harris Research Laboratories. Bertrand W Hayward, newly named President of Philadelphia Textile Institute, will also speak.

Entertainment will be supplied by a PTI faculty musical group, headed by Donald Partridge, dean of students.

Committee members planning the banquet are: Peter J Osborne, R C Osborne & Co, *chairman;* Thomas S Greenwood, Globe Dye Works Co, Edward Haack, General Dyestuff Co; David Herrick, Avis Tricot Sales Co; Charles P Hoffner, Hoffner Rayon Co; Robert H Hood, Robert H Hood Co; G J Littlewood III, G J Littlewood & Son, Inc; Stewart McConaghy, E I duPont de Nemours & Co Inc; Frank L Giese, PTI Faculty; and Mrs E Selma Crane, PTI Alumni Association.

OBITUARY

ALEXANDER ROBERTSON

ALEXANDER ROBERTSON, president of Venango Engineering Co, Philadelphia, Pa, died November 12th in Philadelphia. His survivors include a widow, two brothers, and three sisters.

NAMES IN THE NEWS

Askin

Minich

Peters

SIMON ASKIN, president of Heyden Chemical Corporation, has been elected president and a director of Nuodex Products Company, Inc. Mr Askin also was elected chairman of the board of Nuodex International, a wholly owned subsidiary.

The entire common stock of Nuodex was acquired by Heyden Chemical Corporation on November 1st.

ARTHUR MINICH continues as executive vice president of Nuodex Products Company, Inc and H V WHELAN continues as president of Nuodex International. The position of chairman of the board of Nuodex International is a newly created one.

Four Heyden executives also were elected directors of Nuodex Products Company, Inc in addition to Mr Askin. They include JOHN P REMENSNYDER, chairman of the board, HERMAN SOKOL and ARTHUR BROADMAN, vice presidents, and JAMES K LINDSAY, secretary.

Three new directors elected to the board of Nuodex International included Mr Remensnyder, Mr Askin and Mr Lindsay.

EMIL W PETERS, director of the Hosiery Division of Onyx Oil & Chemical Company for the past 9 years, has tendered his resignation effective January 1, 1955. Mr Peters has been elected president of Advanced Products Corp, New Hope, Pa. This corporation will manufacture and distribute chemical specialties to all phases of the textile and allied industries, and engage in the development of other fine chemical specialties. Mr Peters will also be available for consulting engagements.

R A BINTZ, National Starch Products' Plainfield, N J, plant manager since 1947, has been promoted to the position of assistant director of manufacturing.

JAMES L EDWARDS, plant superintendent at Plainfield since 1946, succeeds Mr Bintz as plant manager, and RUSSELL W BURDGE, with National since 1924, has moved up to plant superintendent.

HERMAN F MARK, director of the Institute of Polymer Research at the Polytechnic Institute of Brooklyn and a world authority on polymers, has been elected chairman of the American Chemical Society's Division of Polymer Chemistry for 1955.

Professor Mark succeeds RAYMOND M FUOSS of Yale University. RAYMOND F BOYER, director of the physical research laboratory of the Dow Chemical Co, has been named chairman-elect. JOSEPH DEC of the Johns-Manville Research Center, is secretary-treasurer.

THOMAS G FOX JR, Rohm & Haas Co, will represent the division in the Council of the Society, and ARTHUR V TOBOLSKY of the Polytechnic Institute of Brooklyn will be alternate councilor.

ROGER WILLIAMS, vice president, member of the board of directors and member of the Executive Committee of E I du Pont de Nemours & Company, Inc, Wilmington, Del, has been chosen to receive the highest award in American industrial chemistry, the Perkin Medal of the American Section of the Society of Chemical Industry, for 1955.

The 1955 award will be the 49th impression of the Perkin Medal, bestowed for outstanding achievement in applied chemistry. Presentation of the medal to Mr Williams will be made at a meeting of the American Section of the Society of Chemical Industry to be held at the Waldorf Astoria Hotel in New York on January 14th, 1955.

Appointed to the newly created position of general sales manager with offices in New York is E H SHELTON, formerly sales manager of the Atlanta sales office, the Tennessee Corporation.

L S KANIECKI was promoted to manager, chemical sales, and H G CUNNINGHAM assistant manager, chemical sales, with offices in Atlanta. R W ALEXANDER was appointed assistant general manager of Tennessee Corporation's Lockland, Ohio, plant. All appointments were effective November 1, 1954.

The title of executive director has been conferred upon IRENE BLUNT of The National Federation of Textiles, Inc by the association's Executive Committee on behalf of the Board of Directors. Miss Blunt will at the same time retain her title of secretary and treasurer, which she has held since 1933.

Stowe-Woodward, Inc, Newton, Mass, has announced the appointment of DAVID W STAPLETON to the position of executive vice president.

Mr Stapleton has been associated with the Udylite Corp, Detroit, Mich, as general manager, since 1953.

Emkay Chemical Co, Elizabeth, N J, has appointed E L RODGERS to handle its technical sales in Georgia and Alabama. Mr Rodgers was formerly with American Aniline Products, Inc, covering the Pacific Northwest, and will cover his new territory from Sylacauga, Ala.

JAMES H KENNEDY, managing editor of Textile World, *has resigned to accept a position as senior associate and administrative assistant with the management-consulting firm of Bruce Payne & Associates, Inc.*

In his new position, Mr Kennedy will divide his time between the New York and Westport, Conn, offices of Bruce Payne & Associates and will also be active in the coordination of activities of branch offices in Boston, Atlanta, Chicago, Montreal, Rio de Janiero, and Sao Paulo.

Stapleton

Rodgers

Kennedy

GEORGE L ROYER has been named administrative assistant to the general manager of American Cyanamid Company's Research Division. He will coordinate policies on budgets, personnel, and publications at the division's laboratories in Stamford, Conn, Pearl River, N Y and Bound Brook, N J.

Dr Royer was the recipient of the Olney Medal in 1950 from the AATCC for outstanding achievements and contributions to the field of textile chemistry.

The appointment of four new assistant district sales managers of Carbide and Carbon Chemicals Co, a Division of Union Carbide and Carbon Corp, has been announced as follows:

R A CORIO———Newark District
R J HUGHES———Philadelphia District
D F SWARTZ, JR———Baltimore District
D H MERRY———Chicago District.

WALTER F FANCOURT III, president, W F Fancourt Company, Philadelphia, is recuperating at home following a recent operation at Hahnemann Hospital, Philadelphia.

The appointment of two southern sales representatives has been announced by the James Hunter Machine Company, North Adams, Mass, and its subsidiary, Hunter Controls, Inc. CARL ENDLEIN will represent Hunter Controls and L V NEESE will represent the parent company.

Until recently, Mr Endlein was in charge of sales in the southern area for the complete line of James Hunter textile dyeing and finishing equipment which Mr Neese will now handle. In his new post, Mr Endlein will represent Hunter Controls in the sale of the Hunter Hygrometer and Electro-Psychrometer moisture and humidity control instruments.

Mr Endlein will continue operations from his offices at 1734 Candler Building, Atlanta, Ga; Mr Neese will be at 3334 Auburn Avenue in Charlotte, N C.

F C Huyck & Sons, Rensselaer, N Y, is now offering the services of R B NEVILLE to the cotton textile industry in general. Mr Neville will be operating in the field constantly in the capacity of field service engineer interested primarily in the Sanforizing* process.

Mr Neville has spent almost a quarter of a century in charge of all Sanforizing at the Lanett Bleachery and Dye Works, West Point, Ga.

* Trade-mark—Cluett, Peabody Co.

New assignments for WILLIAM E DUGAN, JR and RAYMOND C BAXTER have been announced by Solvay Process Division, Allied Chemical & Dye Corporation.

Mr Dugan is named senior assistant plant manager of the chlorine-caustic soda chlorinated methane operations at Solvay's Moundsville, West Virginia plant. Appointed assistant chief engineer of Solvay Process Division, Mr Baxter succeeds Mr Dugan in that post.

Mr Dugan, first employed by Solvay in 1946, has served as assistant chief engineer since 1953. Mr Baxter began working for Solvay in 1941, and he has held the positions of senior engineer and principal engineer.

The appointment of DANIEL M HOLSENBECK, JR, as fiber sales and service representative has been announced by National Aniline Division, Allied Chemical & Dye Corporation. Mr Holsenbeck will cover the Southern States, working out of National's Greensboro, N C office.

Mr Holsenbeck has been for the past five years technical superintendent at Stonecutter Mills, Spindale, N C. In his new position he will be concerned with sales and service of Allied Chemical nylon soon to be produced at National Aniline's Chesterfield Plant now nearing completion at Hopewell and Bermuda Hundred, Va.

Stein, Hall & Co, Inc, New York, has announced the appointment of KENNETH ARNOLD as manager of the Paper Mills Department, ROBERT HAHN as manager of the Chicago Sales Branch and CLEMENT D NEVIN, JR as acting manager of the Cincinnati Sales Branch.

Mr Arnold, who joined Stein, Hall & Co, Inc in 1933, has been manager of the Chicago Branch since 1946, and will now move to the New York Offices.

Mr Hahn, who is succeeding Mr Arnold in Chicago, has been in the Sales Division of the company since 1947 and was appointed manager of the Cincinnati Branch in 1952.

Mr Nevin, succeeding Mr Hahn in Cincinnati as acting branch manager, has been with the Cincinnati sales force since 1952.

E PAUL DUNCAN has been appointed to the sales department of Hooker Electrochemical Co as technical service representative. His headquarters will be at the company's Tacoma, Wash, plant.

New additions to Hooker's research and development department include OSCAR C ZASKE, plastics and resins group; FRANK P AVONDA and DONALD H CAMPBELL, fluorine chemistry group.

GENERAL CALENDAR

AMERICAN SOCIETY FOR TESTING MATERIALS

1955 Committee Week—Jan 31-Feb 4, Netherland Plaza Hotel, Cincinnati, O

1955 Annual Meeting—June 26-July 1, Chalfonte-Haddon Hall, Atlantic City, N J.

AMERICAN SOCIETY FOR QUALITY CONTROL

Annual meeting, Textile Div—Jan 27-29, Clemson College School of Textiles.

DELTA KAPPA PHI FRATERNITY

1955 Annual Convention—April 29-30, Lowell, Mass.

DEUTSCHE GESELLSCHAFT FUR CHEMISCHES APPARATEWESEN

Achema XI—May 14-22, Frankfurt am Main, Germany.

DRYSALTERS CLUB OF NEW ENGLAND

Jan 24, April 29 (Hotel Vendome, Boston, Mass); June 24 (Outing—Wachusett Country Club, W Boylston, Mass).

THE FIBER SOCIETY

Spring Meeting—May 4-5, 1955, Alabama Polytechnic Institute, Auburn, Alabama.

Fall Meeting—Sept 8-9, 1955, Massachusetts Institute of Technology, Cambridge, Mass.

INTERNATIONAL TEXTILE EXHIBITION

2nd Exhibition—June 25-July 10, 1955, Brussels, Belgium.

INTERNATIONAL WOOL TEXTILE RESEARCH CONFERENCE

September, 1955—Sydney, Melbourne, and Geelong, Australia.

NATIONAL ASSOCIATION OF HOSIERY MANUFACTURERS, KNITTED OUTERWEAR ASSOCIATION, THE UNDERWEAR INSTITUTE

42nd Knitting Arts Exhibition—April 25-29, Convention Hall, Atlantic City, N J.

NATIONAL COTTON COUNCIL OF AMERICA

Annual Meeting—Jan 31-Feb 1, Hotel Shamrock, Houston, Tex.

Cotton Research Clinic—Feb 16-18, Pinehurst, N C.

NEW YORK PIGMENT CLUB

Jan 15.

PHI PSI FRATERNITY

52nd Annual Convention — April 7-9, Lowell Technological Institute, Lowell, Mass.

TEXTILE RESEARCH INSTITUTE

25th Annual Meeting—March 10-11, Hotel Commodore, New York, N Y.

STRACTED

OFFICIAL PUBLICATION OF THE PROCEEDINGS AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

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AMERICAN
DYESTUFF REPORTER

Volume 43
January, 1954-December, 1954

Including the
Index to
PROCEEDINGS OF THE
AMERICAN ASSOCIATION OF
TEXTILE CHEMISTS AND COLORISTS

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